

1951, No. 1

MARCH 21

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THE AMERICAN SOCIETY OF ICHTHYOLOGISTS
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Published quarterly by the American Society of Ichthyologists and Herpetologists, at the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, under the Act of August 24, 1912. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized February 11, 1924. Printed by Ann Arbor Press, Ann Arbor, Michigan.

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Zoology,

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by Ann



Fernand Angel, 1881—1950

Fernand Angel, 1881-1950

FERNAND ANGEL, Honorary Foreign Member of the American Society of Ichthyologists and Herpetologists, died July 13, 1950 after 45 years of uninterrupted work in the Laboratory of Zoology (Reptiles and Fishes) of the Museum of Natural History, Paris. His death is a great loss to French herpetology, a science that has been rather forsaken in this country. He was practically the sole qualified representative.

Angel was born at Douzy (Ardennes) on February 2, 1881. He dedicated his entire life to the museum, which he entered in November, 1905 as assistant preparator under Prof. Vaillant. From the beginning of his career he was interested in the study of amphibians and reptiles, and he profited from the instruction of Dr. Mocquard, then Assistant in Herpetology, and of G. A. Boulenger of the British Museum. Angel was appointed Préparateur (Assistant) in Herpetology in 1910, and pursued his researches until his death. His work was interrupted by the first World War, during the course of which he campaigned at the front for four and a half years.

The scientific work of Angel was and remains important. The herpetological faunas of Africa and Asia, particularly of the French colonies, were the objects of his researches. Numerous notes and memoirs on the fauna of west and equatorial Africa are the fruits of the study of the very abundant material collected by travelers and colonial officials. Especially noteworthy is *Les Serpents de l'Afrique Occidentale française*, the first comprehensive study and the basic work for research on the snakes of this region.

Madagascar always attracted Angel because of the peculiarities of its fauna. Thanks to the abundant material at his disposal, he was able to publish more than thirty notes and memoirs on the herpetology of this island. Among the more important are the revision of the genera *Uroplatus* and *Brookesia*, and the monograph of the lizards of Madagascar. The documentation and illustration make the latter a major work.

During recent years Angel put to use the competence acquired during his long herpetological career, supplementing it with the most recent bibliographic data, to produce a number of general works. Among these are *La Vie des Caméléons et autres Lézards*, the volume on amphibians and reptiles in *La Faune de France*, and *La Vie et les Mœurs des Batraciens*. His last work, *La Vie et les Mœurs des Serpents*, has just come from the press. It is a reference book of primary importance both to specialists and to laymen.

Although his main interests were herpetological, Angel was not uninterested in fishes. He made an important contribution to ichthyology, particularly in the volume published in collaboration with Dr. Roule on the deep-sea fishes collected by the Prince of Monaco.

Angel's scientific researches did not cause him to neglect in the least the more thankless but indispensable work on the collections. The classification and preservation of material, especially of the numerous types of Daudin, Duméril and Bibron, A. Duméril, Bocourt, and others, received his careful attention. He thus acquired an extensive knowledge of the herpetological riches of the museum, and it was easy for him to satisfy the many requests for information from herpetologists all over the world who communicated with him.

There is yet another aspect of Angel's work that cannot be passed over in silence: his talent for drawing. His skill may be judged from the plates accompanying his works on fishes, those that illustrate Bocourt's Expedition to México, or the little atlases of color plates of exotic amphibians, reptiles, and fishes.

A careful and conscientious observer of morphological characters, Angel made a career of systematics. During the course of patient studies he acquired an indisputable competence that gave him an important place among the herpetologists of the world. The honorary titles, both French and foreign, that were bestowed upon him testify to this.

All who were associated with him will preserve the memory of this unaffected man, even-tempered and cheerful; of this affable colleague, who placed without reservation his great knowledge at the disposal of all, always ready to give counsel or render a service. Let the memory of this worker be for us a lesson and an example.—J. GUIBÉ, *Sous-Directeur du Laboratoire de Zoologie (Reptiles et Poissons) du Museum, Paris*. [Translation, courtesy of D. DWIGHT DAVIS.]

The Amphibia and Pisces in the First Edition of the *Systema Naturae*

By KARL P. SCHMIDT

IT was something of an occasion to make the acquaintance of the first edition of Linnaeus' *Systema Naturae* through the purchase of a copy of the facsimile edition prepared by the Royal Swedish Academy in Stockholm in 1907. The first edition of this work proves to be a thin folio volume of seven unpaginated leaves, measuring $22\frac{1}{2}$ by $18\frac{1}{4}$ inches (57 x 46 cm.), with a half leaf of illustration of flower parts. I have presented this copy to the Library of the Chicago Natural History Museum. Thanks to the interest of Mr. A. C. Townsend, Librarian of the British Museum (Natural History), I have now

been able to examine original copies of the first edition, as well as the Friedländer facsimile edition of 1881.

The primitive origins of our classification of amphibians and reptiles as class "III. Amphibia" and of the fishes as "IV. Pisces" have bibliographic

CAROLI LINNÆI, SVEDI,
DOCTORIS MEDICINÆ,
SYSTEMA NATURÆ,
SIVE
REGNA TRIA NATURÆ
SYSTEMATICE PROPOSITA
PER
CLASSES, ORDINES,
GENERA, & SPECIES.

O JEHOVA! Quam ampla sunt opera Tua!
Quam ex nimis faciente fructu!
Quam plene est terra possessum tua!

Psalm. civ. 14.

LUGDUNI BATAVORUM,
Apud THEODORUM HAAK. MDCCXXXV.

EX TYPOGRAPHIA
JOANNIS WILHELMI & GROOT.

and historic interest, and it accordingly seems desirable to reproduce them in full for COPEIA. The Amphibia occupy only a third of a column on the first page of the Regnum Animale, and the fishes take a full column on the second page.

III. AMPHIBIA.

Corpus nudum, vel squamosum. Dentes molares nulli : reliqui semper. Pinnae nullae.

SERPENTIA.	Testudo.	<i>Corpus quadrupedum, caudatum, testa munitum.</i>	Testudo tessulata. . terrestris. . marina. Luraria.
	Rana.	<i>Corpus quadrupedum, cauda destitutum, squamis carens.</i>	Bufo. Rana arborea. . aquatica. . Carolina.
	Lacerta.	<i>Corpus quadrupedum, caudatum, squamosum.</i>	Crocodilus. Allegator. Cordylus. Draco volans. Scincus. Salamandra aq. . terrestris. Chamaeleo. Seps. Senembi Mrg.
	Anguis.	<i>Corpus apodum, teres, squamosum.</i>	Vipera. Caecilia. Aspis. Caudifona. Cobras de Cabelo. Anguis Aesculapii. Cenchris. Natrix. Hydrus.

AMPHIBIORUM Classẽm ulterius continuare noluit benignitas Creatoris ; Ea enim si tot Generibus , quot reliquæ Animalium Classẽs comprehendunt , gauderet ; vel si vera essent quæ de Draconibus , Basiliscis , ac ejusmodi monstris οἱ τετραλόγοι fabulantur , certẽ humanum genus terram inhabitare vix posset.

IV. PISCES.

Corpus apodum, pinnis veris instructum, nudum, vel squamofum.

PLAGIURI. <i>Cauda horizontalis.</i>	Thrichechus.	<i>Dentes in utraque maxilla. Dorsum impenne.</i>	Manatus l. <i>Vacca mar.</i>
	Catodon.	<i>Dentes in inferiore maxilla. Dorsum impenne.</i>	Cot. Fistula in rostro <i>Art.</i> Cete <i>Clus.</i>
	Monodon.	<i>Dens in superiore max. 1. Dorsum impenne.</i>	Monoceros. <i>Unicornu.</i>
	Balæna.	<i>Dentes in sup. max. cornei. Dorsum sæpius impenne.</i>	B. Groenland. B. Finfisch. B. Maxill. inf. latiore. <i>Art.</i>
	Delphinus.	<i>Dentes in utraque maxilla. Dorsum pinnatum.</i>	Orcha. Delphinus. Phocæna.
CHONDROPTERY- GII. <i>Pinnæ cartilagineæ.</i>	Raja.	<i>Foramina branch. utring. 5. Corpus depressum.</i>	Raja clav. asp. laev. &c. Squatino-Raja. Ahavela. Pallinaca mar. Aquila. Torpedo. Bos <i>Vet.</i>
	Squalus.	<i>Foram. branch. utring. 5. Corpus oblongum.</i>	Lamia. Galeus. Catulus. Vulpes mar. Zygæna. Squatina. Centrine. Priſtis.
	Acipenser.	<i>Foram. branch. utring. 1. Os edentul. tubulatum.</i>	Sturio. <i>Ichthyocola.</i> Hufo.
	Petromyzon.	<i>Foram. branch. utring. 7. Corpus bipenne.</i>	Ennecephthalmus. Lampetra. Mustela.
	Lophius.	<i>Caput magnitudine corporis. Appendices horizontaliter la- tera piscis ambiunt.</i>	Rana piscatrix. Guacucuja.
BRANCHIOSTEGI. <i>Pinnæ offic. carentes. Branch. oss. & membran.</i>	Cyclopterus.	<i>Pinna ventrales in unicam circularem concretæ.</i>	Lumpus. <i>Lepus mar.</i>
	Ostracion.	<i>Pinna ventrales nullæ. Cutis dura, sæpe aculeata.</i>	Orbis div. sp. Pisc. triangul. Atinga. Hyltrix. Ostracion. Lagocephalus.
	Balistes.	<i>Dentes contigui maximi. Aculei aliquot robusti in dorso.</i>	Guaperua. Hyltrix. Capricus. Caper.

MALACOPTERYGII.
Pinnae offic. , quæ omnes molles.

Gymnotus.	<i>Membr. branch. officul.</i> 5. <i>Pinna dorsalis nulla.</i>	Carapo.
Muraena.	<i>Membr. branch. offic.</i> 10. <i>Tubuli in apice rostri.</i> 2.	Anguilla. Conger. Fluta. Serpens mar.
Blennius.	<i>Pinna ventr. constant offic.</i> 2. <i>Caput admodum decliv.</i>	Alauda non crist. & galer. Blennius. Gattorugine.
Gadus.	<i>Membr. branch. offic.</i> 7. <i>Pinnae dors.</i> 2 vel 3.	Asellus diversar. specier. Merluccius. Anthias 2dus. Mustela. Egresinus.
Pleuronectes.	<i>Membr. branch. offic.</i> 6. <i>Oculi ambo in eodem later.</i>	Rhombus divers. specier. Passer. Limanda. Hippoglossus. Bugloss. Solea.
Ammodytes.	<i>Membr. branch. offic.</i> 7. <i>Pinna ventr. nullæ.</i>	Ammodytes. Talianus.
Coryphæna.	<i>Membr. branch. offic.</i> 5. <i>Pinna dors. à capite ad caudam.</i>	Hippurus. Pompilus. Novacula. Pestes.
Echencis.	<i>Stria transversæ, asperæ, in superna capitis parte.</i>	Remora.
Efox.	<i>Membr. branch. offic.</i> 14.	Lucius. Belone. Acus maxima squamosa.
Salmo.	<i>Membr. branch. offic.</i> 10-12. <i>Corpus maculosum.</i>	Salmo. Trutta. Umbla. Carpio lacustr.
Osmerus.	<i>Membr. branch. offic.</i> 7 - 8. <i>Dentes in max. lingu. palat.</i>	Eperlanus. Spirinchus. Saurus.
Coregonus.	<i>Membr. branch. offic.</i> 8-10. <i>Appendix pinniformis.</i>	Albula. Lavaretus. Thymallus. Oxyrhynchus.
Clupea.	<i>Membr. branch. offic.</i> 8. <i>Venter acutus ferratus.</i>	Harengus. Spratti. Encrasicholus. Alofa.
Cyprinus.	<i>Membr. branch. offic.</i> 3. <i>Dentes ad orificium ventriculi tantum.</i>	Erythrophthal. Mugil. fluvi. Brama. Ballerus. Capito. Nafus. A. M. Carassius. Cypr. nobilis. Tinca. Barbus. Rutilus. Alburnus. Leuciscus. Phoxinus. Gobius fl.
Cobitus.	<i>Caput compressum.</i> <i>Pinna dors. & ventrales eadem à rostro distantia.</i>	Cobitis. Barbatula. Misgurn.
Syngnathus.	<i>Opercula branch. ex lamina r.</i> <i>Maxilla à lateribus clausæ.</i>	Acus lumbr. Acus Aristot. Hippocampus.

Beneath the account of the Amphibia is a half column devoted to "Paradoxa." These include such items as Hydra, Phoenix, and Draco, together with "Rana—Piscis s. Rana in Piscem metamorphosis."

With the heading *Caroli Linnaei Sveci Methodus*, and the date 1736, a separate page summarizes Linnaeus' proposed method for elaborating the classification of the Animal Kingdom. This was inserted in some copies of the

ACANTHOPTERYGII. Pinne offic. , quantum quoddam aculeatæ.	Gasterosteus.	<i>Membr. branch. officulis 3.</i> <i>Venter laminis ossis instr.</i>	Aculeatus. Spinachia.
	Zeus.	<i>Corpus compressum.</i> <i>Squama subasperæ.</i>	Pungitius.
	Cottus.	<i>Membrana branch. offic. 6.</i> <i>Caput aculeatum , corpore latius.</i>	Aper. Gallus mar.
	Trigla.	<i>Appendices ad pinn. pect. articulatæ 2 vel 3.</i>	Cataphractus. Scorpio mar.
	Trachinus.	<i>Opercula branch. aculeata.</i> <i>Oculi vicini in vertice.</i>	Cottus. Gobio fl. capir.
	Perca.	<i>Membr. branch. officul. 7.</i> <i>Pinna dorsales. 1 vel 2.</i>	Lyra. Gurnardus.
	Sparus.	<i>Opercula branch. squamosa.</i> <i>Labia dentes tegunt.</i> <i>Dentes molares obtinet.</i>	Cuculus. Lucerna.
	Labrus.	<i>Labia crassa dentes teg.</i> <i>Color speciosus.</i>	Hirundo. Milvus.
	Mugil.	<i>Membr. branch. offic. 6.</i> <i>Caput totum squamosum.</i>	Mullus barb. & imberb.
	Scomber.	<i>Membr. branch. offic. 7.</i> <i>Pinna dorfi 2 vel plures.</i>	Draco. Araneus mar.
	Xiphias.	<i>Rostrum apice ensiformi.</i> <i>Pinna ventrales nullæ.</i>	Uranoscopus.
	Gobius.	<i>Pinna vent. in 1 simpl. concy.</i> <i>Squama asperæ.</i>	Perca. Lucioperca.
			Cernua. Schraitser.
			Salpa. Melanurus.
			Sparus. Sargus.
			Chromis. Mormyrus.
			Mæna. Smaris.
			Boops. Dentex.
			Erythrinus. Pagrus.
			Aurata. Cantharus.
			Julis. Saccettus.
			Turdus diversar. specier.
			Mugil. Cephalus.
			Glaucus. Amia.
			Scomber. Thynnus.
			Trachurus. Saurus.
			Gladius.
			Gob. niger. Jozo.
			Paganellus. Aphua.

original first edition, and is included in the 1907 facsimile. It was reprinted as an appendix in the subsequent editions from the second to the ninth, but was thereafter omitted. As it proves to be of more than bibliographic interest I shall elsewhere present a translation of it and comment further upon it.

CHICAGO NATURAL HISTORY MUSEUM, CHICAGO 5, ILLINOIS.

Ictalurus lambda, a New Catfish, Based on a Pectoral Spine from the Lower Pliocene of Kansas¹

By CARL L. HUBBS and CLAUDE W. HIBBARD

THE pectoral spine herein described as *Ictalurus lambda* is referred to the family Ameiuridae, of the siluroid (nematognathous) division of the Ostariophysi, not only because it agrees most satisfactorily with the pectoral spines at hand of Recent species of that family, but also because of varied circumstantial evidence. This family comprises the North American freshwater catfishes and is thought to date, at least, from the Eocene. It is a plausible inference that this group lived in the streams that laid down the Ogallala formation in a climate that appears to have been mild-temperate.

It is highly improbable that the spine should be referred to the rather similar South American family Pimelodidae. That group now ranges northward only to southern Mexico and probably did not occur much farther north in the Pliocene. In fact, Middle America appears to have been invaded only recently by the pimelodids, for the many Middle American species are all referred to *Rhamdia*, which is only one of the numerous South American genera. Similarly, Middle America seems to have been invaded by only one genus of the Cichlidae, namely *Cichlasoma*, which has subsequently undergone only specific and weak generic differentiation. Other South American derivatives have passed through little evolutionary change in Middle America. A plausible assumption is that the northward dispersal followed the closure of the Panama Portal, probably in Pliocene time. There are no reasons to suspect the pertinence of the fossil to any other Neotropical family of the Nematognathi (Siluroidea) or to any Old-World family.

Reference of the spine to the Ariidae (the marine catfishes) also appears improbable, for it is only within the tropics that a few representatives of that family have become established in fresh water. It is not to be expected that an ariid would have penetrated to the northward and into the interior as far as Kansas during the mild-temperate Pliocene.

Certain differences in structure, outlined below, confirm the separation of the fossil from *Rhamdia* and from the Ariidae.

The spine is tentatively placed in the genus *Ictalurus* because of its large size, because of certain points of agreement in structure, and because it is plausible to assume that this primitive genus of the Ameiuridae occurred in the Kansas region during the Lower Pliocene.

TERMINOLOGY OF PECTORAL SPINE

In order to describe this pectoral spine completely and understandably and to compare it with the spines of Recent species, it is necessary to propose terms for the complex processes and recesses of the locking mechanism. The

¹ Contributions from the Scripps Institution of Oceanography, New Series, No. 492, and from the Department of Geology of the University of Michigan.

terminology of previous workers has been found inadequate. Thilo (1896) used descriptive German terms. Sørensen (1898) assigned Greek letters to the processes and used a few descriptive English terms. Merriman (1940) used numbers, correlating them with the Greek letters of Sørensen.

The structures are readily homologized throughout the Ameiuridae, Pimelodidae and Ariidae, as these families are represented by pectoral spines in the University of Michigan Museum of Zoology. The terms anterior and posterior are applied to the spine as it is seen when locked at right angles to the body.

The *shaft* (Pl. II, Fig. 1) of the pectoral spine is flattened dorsoventrally. The *anterior edge* (Pl. I, Fig. 3), called "the foremost denticulated edge of the ray" and "R" by Sørensen, is usually ridged and often bears *anterior dentations* (Pl. III, Fig. 1). The *posterior edge* (Pl. II, Fig. 2) is more often or more strongly dentate (Pl. I, Fig. 4). The dentations may be *antrorse* when directed more or less distad, *retrorse* when directed proximad, or *erect*. Proximally, where reduced in size, the *posterior dentations* may arise from a *posterior groove* (Pl. III, Fig. 2), which extends toward the distal end of the basal recess, described below. Distally, just beyond the last of the posterior dentations, there is a bony point, the *end of the ossification* (Pl. 2, Fig. 1), where spinous structure abruptly gives way to the soft, segmented, and often more or less filamentous tip of the first ray. The *basal recess* (Pl. II, Fig. 2) is a deep cavern on the posterior face of the base of the shaft of the spine. Its outer rim is rather indistinct. At its distal end, the cavity of the recess is continuous, openly or through a pore, with the hollow center of the spine. The proximal face of the basal recess is largely occupied by a more or less elevated articulating *basal process* (Pl. III, Fig. 2). Adjacent to this process, across the proximal face of the base of the spine, is a more or less oval *central articulating surface* (Pl. II, Fig. 2), which usually has two more or less distinct surfaces, of which the *ventral facet* (Pl. I, Fig. 1) is smaller than the *dorsal facet* (Pl. I, Fig. 1). The rims of the central articulating surface are more or less elevated. In some species, in which it is especially elevated, the posterior rim may be known as the *posterior process* (Pl. I, Fig. 4). It is generally much less conspicuous than the three major processes—dorsal, anterior, and ventral.

The dorsal process (Pl. III, Fig. 1) is much the largest. It was called "8" by Sørensen, "arched crest" by Burkenroad (1931), and "2" or "an arched crest of base" by Merriman. This process arises abruptly from the flattened dorsal surface of the base of the spine. Its proximal face is very broad and more or less concave. The outer edge is variably arched (convex outward) and is either rounded or flattened. On the proximal face of the process, close to the dorsal end of the central articulating surface, and just ventral to the edge of the finely sculptured *dorsal articulating surface* (Pl. I, Fig. 1), the *proximal tubercle* (Pl. II, Fig. 2) is more or less evident. It may be obsolescent, somewhat compound, or modified into a ridge. Toward the base of the posteroproximal edge of the dorsal process, and outside the posterior process, is a shallow to deep, straight or angulated, more or less lanceolate *posterior fossa* (Pl. III, Fig. 2). At the opposite, anterior part of

the base of the spine, between the dorsal and anterior processes, is a more or less definite *anterior fossa* (Pl. II, Fig. 1), pointed at the distal end and open proximally. The fossa may be continued as a shallow groove on the anterodorsal face of the anterior process. Opposite the open end of the fossa is a strong strut, of varying shape, connecting the dorsal and anterior processes. This structure will be referred to as the *proximal crest* (Pl. II, Fig. 1).

The *anterior process* (Pl. II, Fig. 3), the most proximal projection, is a more or less capitate structure with a roughened *proximal articulating surface* (Pl. II, Fig. 3). The shape of the process and the orientation of the articulating surface are often distinctive. The anterior process is the "β" of Sørensen; the "1" of Merriam. The anterior process is separated from the ventral process by a deep U- or V-shaped *anteroventral emargination* (Pl. II, Fig. 1).

The *ventral process* (Pl. II, Fig. 1) arises at the proximal end of a basal ridge on the ventral face of the spine. Its base is more flattened than the base of either the dorsal or the anterior process. It varies much in shape but is usually bicapitate, with a *proximal lobe* (Pl. II, Fig. 3) and a *distal lobe* (Pl. II, Fig. 2), between which a *ventral fossa* (Pl. II, Fig. 3) may be developed. In addition, in some species, there is a *ventral rim of ventral process* (Pl. II, Fig. 2), on the ventral edge of the distal lobe, and a *dorsal rim of ventral process* (Pl. II, Fig. 2) on the dorsal edge of the proximal lobe.

AGE VARIATION IN THE PECTORAL SPINE

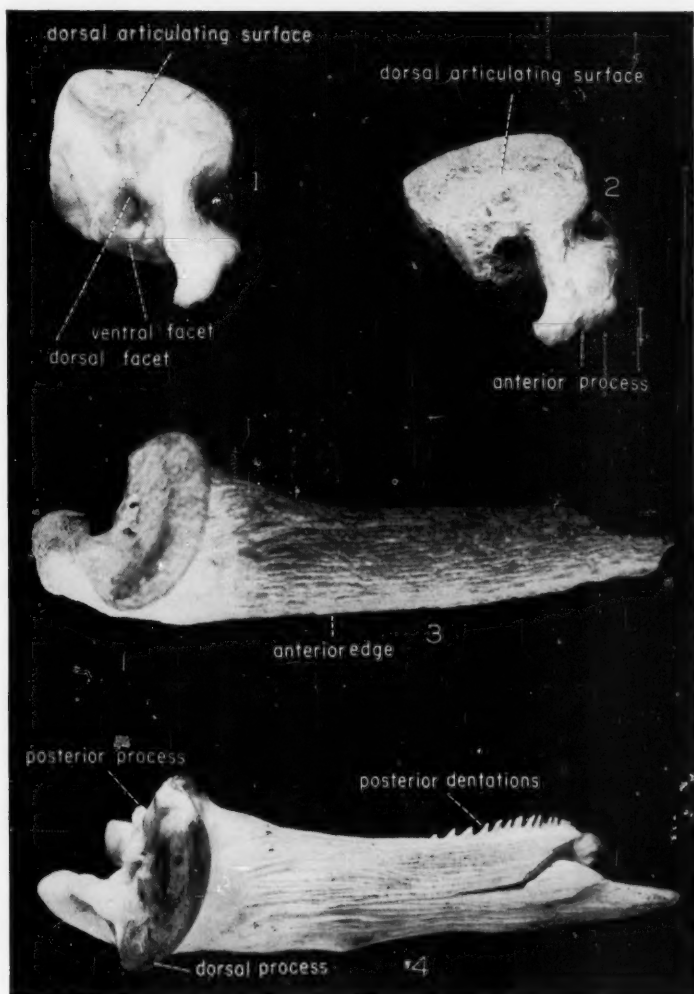
With the increasing age of the fish, the spine changes enormously in structure. It becomes much heavier and relatively shorter and the tip often becomes broken. In many species the surface becomes striated and rugose. The dentations increase in number and become shorter, blunter, more or less serrated, partly fused, and often obsolescent. They commonly change from retrorse to antrorse, or become very irregular in orientation. Great care, therefore, must be taken in the identification of isolated fossil spines. In the present study, however, age variation is of no particular concern, since the two specimens are spines of large adults.

Ictalurus lambda, n. sp.

Pl. I, Figs. 2, 3; Pl. III

HOLOTYPE.—No. 6887, Museum of Natural History, University of Kansas, a left pectoral spine, with tip broken and ventral process (Pl. III, Figs. 2, 3) lost; greatest length, 75.0 mm. (see Table I for measurements). Collected by Claude W. Hibbard, August 17, 1943.

REFERRED MATERIAL.—No. 6888, Museum of Natural History, University of Kansas, the base of a right pectoral spine, somewhat smaller than the holotype, with the processes broken; greatest length, 26.5 mm. Though it is imperfect, this specimen seems to agree satisfactorily with the holotype. It was collected by L. F. Phillis at the type locality, in association with a jaw of *Eucastor* and isolated teeth of *Nannippus* (Hibbard and Phillis, 1945). The few measurements that can be taken are included in Table I.



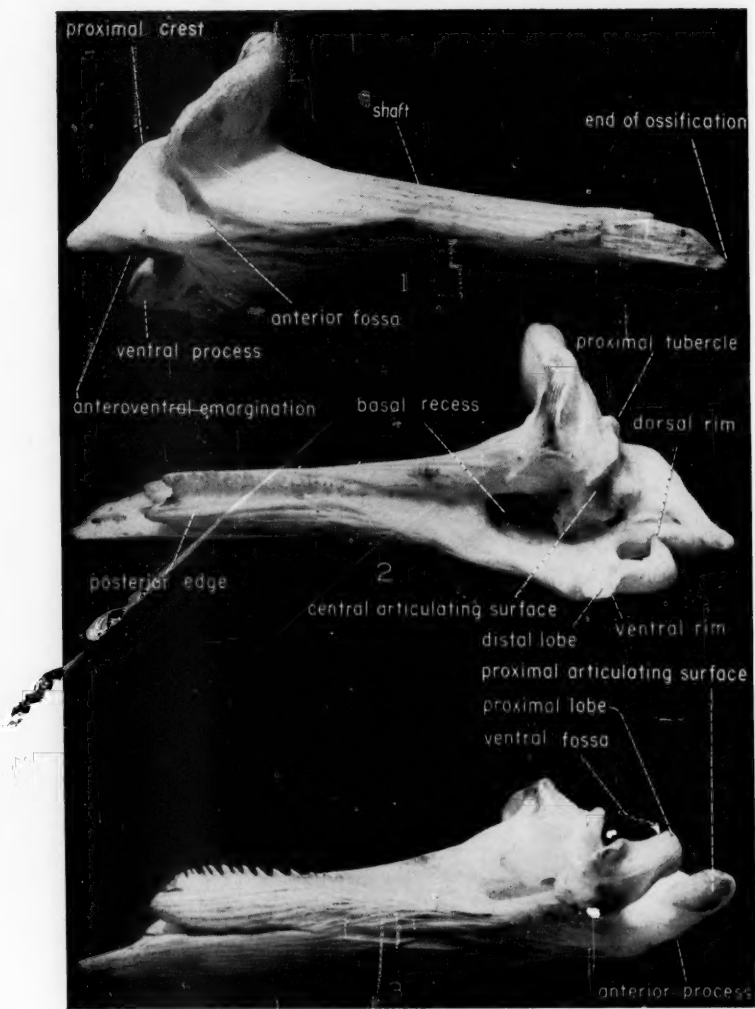
Left pectoral spines of *Ictalurus furcatus* and the holotype of *I. lambda*.

Fig. 1. Proximal view of pectoral spine of *Ictalurus furcatus* with ventral process blacked out to facilitate comparisons.

Fig. 2. Proximal view of pectoral spine of *Ictalurus lambda*; ventral process lacking.

Fig. 3. Dorsal view of left pectoral spine of *Ictalurus lambda*.

Fig. 4. Dorsal view of left pectoral spine of *Ictalurus furcatus*.

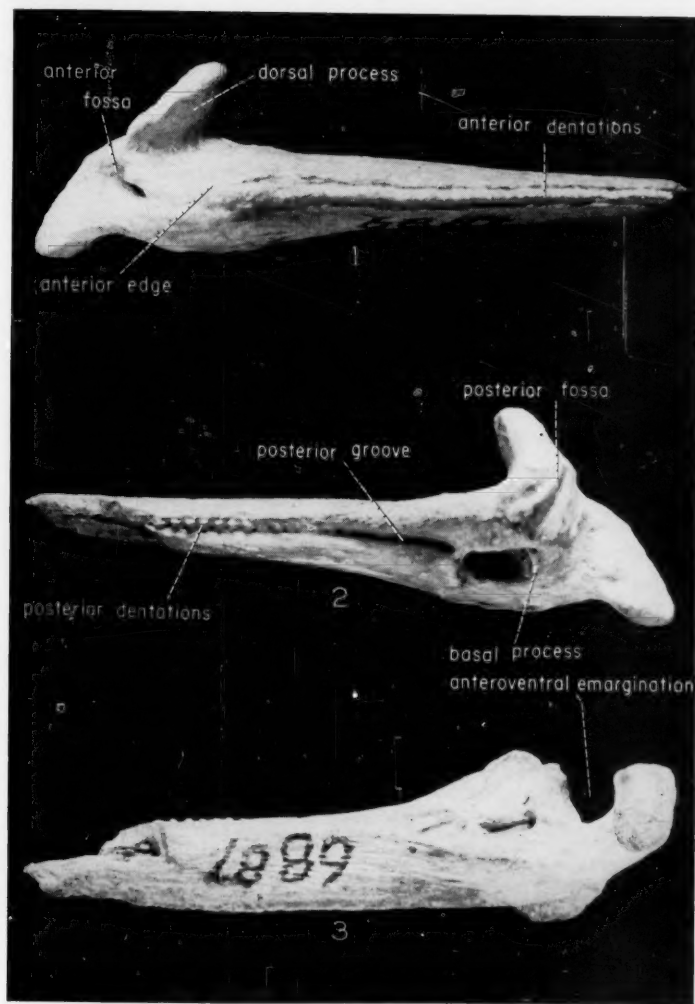


Left pectoral spine of *Ictalurus furcatus*, from Kansas River; spine 75.4 mm. long (also illustrated on Pl. I, Figs. 1 and 4).

Fig. 1. Anterior view.

Fig. 2. Posterior view.

Fig. 3. Ventral view.



Left pectoral spine of holotype of *Ictalurus lambda*.

Fig. 1. Anterior view.

Fig. 2. Posterior view.

Fig. 3. Ventral view.

TABLE I
MEASUREMENTS OF PECTORAL SPINES OF AMELIURID FISHES

The greatest length of the spine and the greatest distance between the margins of the dorsal and anterior processes are given in millimeters; the other

TABLE I
MEASUREMENTS OF PECTORAL SPINES OF AXELIURID FISHES

The greatest length of the spine and the greatest distance between the margins of the dorsal and anterior processes are given in millimeters; the other measurements are expressed both in millimeters and as thousandths of the distance between the margins of these processes.

Character	<i>Ictalurus lambda</i> Type No. 6887		<i>Ictalurus lambda</i> No. 6888		<i>Ictalurus furcatus</i> Kansas River		<i>Ictalurus furcatus</i> Kansas River		<i>I. l. lacustris</i> Ohio		<i>I. l. lacustris</i> Lake Erie		<i>Piloditis olivaris</i> Indiana	
	Left spine	Right spine	Left spine	Right spine	Left spine	Right spine	Left spine	Right spine	Left spine	Right spine	Left spine	Right spine	Left spine	Right spine
Greatest length of spine.....	75.0*	26.5*	75.4*	63.1	97.8	63.1	67.6	60.2	67.1					
Distance between margins of dorsal and anterior processes.....	31.2	....	33.9	16.5	32.6	16.5	20.2	20.8	20.2					
Length of dorsal process.....	22.36 (717)	....	22.46 (663)	12.75 (773)	22.23 (682)	12.75 (773)	14.2 (703)	14.7 (707)	14.2 (703)					
Elevation of dorsal process above base of spine.....	7.6 (244)	7.5	11.9 (351)	5.23 (317)	12.15 (373)	5.23 (317)	7.9 (391)	7.5 (361)	6.2 (307)					
Width of dorsal process to nearest point of rim of central articulating surface.....	13.3 (426)	11.1	12.9 (381)	6.7 (406)	13.0 (399)	6.7 (406)	9.3 (460)	8.7 (418)	7.6 (376)					
Height of anterior process above dorsal end of base of central articulating surface.....	17.1 (548)	....	20.6 (608)	8.8 (533)	19.6 (601)	8.8 (533)	11.2 (554)	12.0 (577)	12.3 (609)					
Maximum width of proximal articulating surface†.....	10.0 (321)	....	5.8 (171)	4.3 (261)	6.2 (190)	4.3 (261)	5.1 (253)	5.4 (260)	5.9 (292)					
Length of proximal articulating surface‡.....	6.9 (221)	....	8.9 (263)	4.7 (285)	7.8 (239)	4.7 (285)	5.2 (257)	6.7 (322)	4.65 (230)					
Distance between margins of anterior process and basal process.....	18.1 (580)	....	20.6 (608)	11.8 (715)	19.3 (592)	11.8 (715)	13.0 (644)	12.3 (591)	12.1 (599)					
Width (near middle) of anterior fossa on anterior surface between dorsal and anterior processes.....	2.4 (77)	3.0	6.9 (204)	2.5 (152)	7.2 (221)	2.5 (152)	4.2 (208)	4.9 (236)	3.2 (158)					
Width (anteroposterior) of spine.....	10.7 (343)	....	11.9 (351)	5.0 (303)	10.9 (334)	5.0 (303)	5.7 (282)	5.9 (284)	8.6 (426)					
Dorsoventral width at same point.....	6.1 (196)	....	6.2 (183)	4.2 (255)	6.0 (184)	4.2 (255)	5.0 (247)	4.9 (236)	5.0 (247)					
Length of posterior fossa.....	9.8 (314)	8.1	12.2 (360)	6.2 (376)	11.7 (359)	6.2 (376)	7.3 (361)	7.5 (361)	8.0 (396)					
Width of posterior fossa.....	5.1 (163)	3.9	5.5 (162)	2.8 (170)	5.4 (166)	2.8 (170)	3.1 (153)	2.8 (135)	4.0 (198)					
Length of central articular surface.....	8.2 (263)	8.0	11.0 (325)	6.7 (406)	12.4 (380)	6.7 (406)	7.8 (386)	7.4 (356)	10.35 (103)					
Width of central articular surface.....	5.0 (160)	4.8	7.8 (230)	3.4 (206)	6.9 (212)	3.4 (206)	4.6 (228)	3.9 (188)	4.4 (218)					
Length of basal recess (between outside rims).....	9.4 (301)	8.0	11.8 (348)	7.1 (430)	12.5 (383)	7.1 (430)	8.8 (436)	9.1 (438)	13.2 (653)					
Width of basal recess near middle.....	4.5 (144)	3.3	6.5 (192)	3.4 (206)	6.7 (205)	3.4 (206)	3.9 (193)	3.5 (168)	5.2 (257)					
Greatest diameter of basal process.....	3.7 (119)	....	6.2 (183)	4.2 (255)	5.6 (172)	4.2 (255)	4.3 (213)	4.1 (197)	5.1 (252)					
Height of basal process at anterior margin.....	1.7 (54)	....	2.7 (80)	0.9 (55)	2.6 (80)	0.9 (55)	0.8 (40)	0.5 (24)	2.9 (144)					

* Spine broken

† Parallel to articulating surface, at right angles to the axis

‡ In line with axis of spine

§ At a distance, distal to basal recess, equal to distance between margins of dorsal and anterior processes, denatations included

HORIZON AND TYPE LOCALITY.—Lower Pliocene, Ogallala formation, Trego County, Kansas, locality No. 29 (of the University of Kansas), in the southwest corner of Sec. 15, T. 11 S., R. 22 W.

DESCRIPTION OF HOLOTYPE.—In the following description of the holotype the spine structures are described in the sequence that is used in the preceding explanation of terminology.

The *anterior edge* is a definite ridge, with a rather deep marginal groove on each side and with numerous rather obscure dentations on the outer half (Pl. III, Fig. 1). The ridge is rather sharp, not rounded as it is in the adult of *Ictalurus furcatus* (Pl. II, Fig. 1), and the grooves are deeper and the dentations more definite. In *I. lacustris* these structures become obsolescent with age, though in the young the anterior edge is definitely denticulate, whereas in *I. furcatus* at like size the sharp anterior ridge is entire. In *Pilodictis* the anterior dentations are unusually well developed in the adult. In *Ameiurus* and in other catfishes these structures as well as the posterior dentations are often characteristic of the species, as is indicated in the ichthyological literature (for example, for the Pimelodidae and for the Doradidae by Eigenmann, 1917, pl. 35; 1925, pls. 2-27).

The *posterior dentations* are definite on the outer 1.5 cm. of the *posterior edge*, as preserved (Pl. III, Fig. 2). They lie in a relatively deep *posterior groove*, above the dorsal edge of which only the outer larger ones rise. The groove remains unusually distinct to its abrupt proximal end, only 2.0 mm. (in posterior projection) from the distal end of the basal recess. Small pits and rugosities suggest that small dentations persisted to the proximal end. In the adult of *I. furcatus* the dentations rise well above the dorsal rim of the shallow posterior groove, which becomes very broad and indefinite at its proximal end. In the adult of *I. lacustris* the dentations remain rather large and the groove is poorly developed. In *Ameiurus* the conditions are various. In *Pilodictis* adults the posterior dentations are strong and definitely antorse.

The *basal recess* (Pl. III, Fig. 2) is comparatively small (Table I), but grades like a funnel into the hollow of the spine. In *I. furcatus* the distal opening into the hollow of the spine is smaller, and in *I. lacustris* the opening is a porelike foramen. In *Ameiurus* the condition is much as in *I. furcatus*. In *Pilodictis* the distal opening is very broad and in smaller specimens is constricted by a cross ridge on the floor of the recess. In *Rhamdia* the opening into the middle of the spine is obsolescent. In the ariids at hand the opening is broad.

The *basal process* (Pl. III, Fig. 2) is a moderately elevated, concave-topped peg, somewhat better developed than in *I. furcatus* and much higher and sharper than in *I. lacustris*. In *Ameiurus* and *Pilodictis* it is moderately developed; in *Rhamdia* it is scarcely evident; in the ariids it is replaced by a more or less developed but flat articulating surface.

The *central articulating surface* (Pl. III, Fig. 2) is relatively much smaller than in *I. furcatus* or *I. lacustris* (Table I). The *dorsal facet* is considerably larger than the *ventral facet*. The angle between the two flat surfaces is about 25°. In the largest spines of *I. furcatus* this angle is 36° to 37° and the dorsal facet is concave. In smaller specimens and in all the spines of

I. lacustris and of *Ameiurus* at hand, the surface is more groovelike and there is little differentiation into dorsal and ventral facets.

The rim of the central articulating surface is low, even on the *posterior process*. Weathering may be responsible, in part, for the lowness of the rim, but it is unlikely that the rim was ever high. It is moderately developed in recent species of *Ictalurus*, *Ameiurus* and *Pilodictis*. In *Rhamdia* the posterior process is a large knob, but elsewhere the rim is weakly developed. In the ariids the posterior process is variously developed. The anterior rim is obvious in *Bagre marinus*, but in *Galeichthys felis* and in *Selenaspis hertzi* the anterior rim is obsolescent, for the articulating surface grades into the proximal crest.

The *dorsal process* (Pl. III, Fig. 1) is less elevated above the dorsal face of the spine than it is in most species (Table I). The angle between the process and the spine is 75° . The concavity of the proximal surface is moderate. The *proximal tubercle* is inconspicuous. The edge of the process is narrowed and rounded transversely, not forming a flat band as it does in *Rhamdia* and in the Ariidae at hand.

The *posterior fossa* (Pl. III, Fig. 2) is pyriform, of moderate size (Table I), and rather deep: the walls in the outer part form an angle of about 115° ; in the inner part of the trough, an angle of about 55° . The angulation on the axis is 162° . The narrower tip of the fossa ends abruptly at the base of the proximal surface of the process. A line across the rims of the fossa near its middle forms an angle of 45° with the tangent to the base of the spine. The axis of the basal part of the fossa forms an angle of 115° with the posterior groove. In the recent species of *Ictalurus* the posterior fossa is usually shallow and its axis forms more nearly a right angle with the posterior groove. In *Ameiurus* it is curved and is continued nearly to the tip of the posterior face of the dorsal process. In *Pilodictis* the posterior fossa is broad and is bent so sharply that the outer borders form approximately a right angle but the fossa ends in a rim well within the tip of the posterior face of the dorsal process. In *Rhamdia* the fossa is very shallow to obsolescent. In the ariids it is also very shallow.

The *anterior fossa* (Pl. III, Fig. 1) is very deep and very narrow (Table I). The width is sharply constricted by an angulation and tuberculation of the dorsal rim. At the tubercle the fossa is as deep as wide. The fossa continues as a shallow groove approximately in line with the axis of the spine. In *I. furcatus* (Pl. II, Fig. 1) the fossa is much broader and is very little constricted medially. In *I. lacustris* the shallow groove beyond the fossa is curved so as to continue along the anterodorsal face of the anterior process. In *Ameiurus* and *Pilodictis* the fossa approaches that of *I. furcatus*. In *Rhamdia* it is very shallow; in the ariids, it is moderately shallow.

The *proximal crest* (Pl. III, Fig. 1), about as in *I. lacustris*, is a massive, very low, little-curved ridge, that ends at the extreme base of the proximal face of the dorsal process. In *I. furcatus* (Pl. II, Fig. 1) it is narrower dorsally and is more arched. In *Ameiurus* the crest is much more arched and is rather strongly sigmoid. In *Pilodictis* it is high, narrow, and moderately sigmoid. The crest is very different in the Pimelodidae and the Ariidae, as repre-

sented by the specimens at hand. In *Rhamdia* it is a very short commissure that extends from the dorsal process merely to the base of the anterior process. In the ariids it is a high, thin, somewhat sigmoid crest that extends from the tip of the anterior process well onto the proximal face of the dorsal process.

The *anterior process* (Pl. I, Fig. 2) is exceptionally massive (Table I). As seen from the proximal face its axis is bent at an angle of 132° ; from the ventral face, 115° . The angle of the anterior rim is 120° . Because of this sharp angulation, the process in ventral view (Pl. III, Fig. 3) is L-shaped (hence the specific name *lambda*). The angulation brings the long axis of the articulating surface into an angle of 100° with the axis of the spine. In most catfishes the two axes are on almost the same line. In *I. furcatus* and in *I. lacustris* the articulating surface is little angulated. In *I. lacustris* it is somewhat broadened. In *Ameiurus* there is a rather pointed expansion directed posteriorly, not a broad squarish expansion as in *I. lambda*. In *Pilodictis* the neck of the process is more slender in ventral view and the rounded articulating head is expanded anteriorly as well as posteriorly. In *Rhamdia* the process is more compressed and is strongly hooked posteriorly. In the ariids the shape of the process is various. The characters of the ventral process are indeterminate, as this process is missing in both specimens. It may be noted, however, that *I. furcatus* differs from *I. lacustris* in the strongly upturned dorsal rim of the proximal head (Pl. II, Fig. 2).

In so far as its characters are evident, specimen No. 6888 appears to be specifically referable to *I. lambda*. Most of the resemblances are reflected in the measurements (Table I). The posterior groove of the second specimen agrees with that of the holotype in being deep and narrow to the edge of the basal recess. In both specimens the spine is rather finely striated and the dorsal articulating surface (Pl. I, Fig. 2) is finely punctate.

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MICHIGAN, ANN ARBOR, MICHIGAN.

Growth Characteristics of the Poeciliid Fish *Platypoecilus maculatus*¹

By FRANCES E. FELIN

ONE of the primary problems in fishery biology is that of distinguishing discrete populations of food fishes. This is frequently done by morphometric studies of local forms, and Ehrenbaum (1929) has pointed out that such studies have "not merely a theoretical but also . . . practical importance in the interests of rational utilization of the stock."

It has been suggested by Lea (1929) that growth characters might serve as accessory race characters. He and his associates have shown that the scale patterns in Norwegian herring, *Clupea harengus* Linnaeus, reflect differences in growth types, and also reveal place of origin and the stock to which an individual or a population belongs.

Ford (1933) experimented with regression equations of the type $y = a + bx$ as a technique for the comparison of growth in length in different geographical areas. Other biologists, for example Bückmann (1938) also have discussed the application of this equation to growth phenomena. This technique is based on the correlation between calculated length of herring at the formation of a given winter ring (l_n) and the calculated length at the time the next ring is laid down (l_{n+1}). Thus $l_{n+1} = a + bl_n$. The formula also indicates that growth follows a geometric progression with annual increments becoming smaller and smaller in constant ratio. Differences due to annual changes in conditions of growth are recognized, however, and the geometric law is regarded as the smoothing out of real fluctuations which are likely to recur year after year.

Differences in growth between herrings of different geographical areas were expressed by Ford in a series of regression equations and calculated "limiting values," or asymptotic limits of growth, which changed from south to north. These growth equations were derived from data on mean calculated lengths of herring from l_1 to as old as l_{13} caught in the North Sea, the English Channel and off Iceland. The values for the slope of the regression lines varied from around 0.6 in Lowestoft herring to 0.74 for the Icelandic forms, with predicted ultimate size (y-intercept \div complement of slope) similarly differing from 27.5 cms. in the south to 36.2 cms in the north.

Walford (1946) described a convenient graphic method for plotting that part of the growth that lies beyond the inflection point of the ordinary sigmoid curve that is derived by plotting length against age. He "transformed" this portion of the usual curve into a straight line by plotting length at age $n + 1$ against length at age n . This was shown to apply commonly (but not always) to the growth of individuals of various types of organisms from clams to man, as well as to averages of groups of individuals in a population.

Walford (*op. cit.*) derived two "growth characteristics," the same as the slope and the "limiting value" derived by Ford from the regression equations. These characteristics, descriptive of the growth of different organisms, he

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designated as k , the slope of the transformation line, and l_{∞} , the asymptotic limit of growth. The constant k is less than unity and represents an average ratio of successive growth increments to the increment of the preceding year. It is a measure of the rate of deceleration of growth:

$$k = \frac{l_n - l_{n-1}}{l_{n-1} - l_{n-2}}$$

The value l_{∞} is the length at which the decelerating growth rate approaches zero and is determined by dividing the y-intercept of the transformation line by the complement of the slope.

Tåning (1944) has shown that experimental proof may be obtained as to whether a certain habitat form is genotypic or phenotypic. If growth characteristics are phenotypically plastic, one might look for their modification with alteration of single factors in the environment.

Preliminary to the application of Walford's graphic technique to the study of pilchard growth, it has appeared desirable to test experimentally the effects on growth of rather small differentials in environmental factors. For this purpose an ovoviviparous aquarium fish, *Platypoecilus maculatus* (Günther), of one genetic strain, has been studied. The stock was of the variegated type said by Innes (1944) to be similar to the common wild types native in southern Mexico. These fishes could be measured exactly (the lengths not merely estimated from scales) at regular intervals. Walford noted that the usual growth curves are difficult to compare and classify. His graphic method of treating that part of the curve above the inflection point, which can be approximated by a straight line, has been applied to these data.

To test the effect of establishing a differential with respect to one environmental factor, temperature, on the growth characteristics of *Platypoecilus maculatus*, a single brood of 45 was divided into approximately equal parts and placed in two 15-gallon aquaria. Whether growth characteristics, like certain meristic characters, are determined during the limits of a particular ontogenetic fixative or formative period (after which the characters remain virtually set) is not known for this species. Likewise it is unknown to what extent there is lability in growth characteristics after "birth" in such ovoviviparous fishes. The present experiment tests only the extent to which such modifications occur in response to a reasonably constant temperature difference in the two halves of the brood when separated two and a half days after birth.

The helpful interest of those persons who have been in charge of the U. S. Fish and Wildlife Service South Pacific Fishery Investigations, Mr. O. Elton Sette, Dr. Lionel A. Walford, and Mr. John C. Marr, is gratefully acknowledged. I also wish to thank Dr. Willis H. Rich who has read a first draft of the manuscript and offered constructive suggestions. Thanks are also due Mr. E. Frederick Smith, collector for the department of biological sciences at Stanford University, who kindly furnished a large brood of platies which were born in his laboratory.

METHODS

Temperatures in two aquaria, tank A and tank B, were maintained by two heating units regulated by thermostats. Readings, made at approximately 9 o'clock each morning on week days, gave mean temperature for the duration of the experiment (19 months) of 22.1° C. (71.8° F.) in tank A and 23.4°

C. (74.2° F.) in tank B; an average difference between the two tanks of 1.3° C. (2.3° F.) The standard deviations of the average weekly temperatures was 2.8° C. for tank A and 2.9° C. for tank B. Confidence limits for the means at the 95% level lie between 21.5° and 22.7° for tank A, and 22.7° and 24.1° for tank B.

In the experience of aquarists (Innes, *op. cit.*) *Platypoecilus* endures a temperature range of 65° to 90° but does best at about 74° F. The thermal tolerances of platies, such as those described for other fishes by Fry (1947), have, so far as I know, not been determined. The rather small temperature differential maintained in the two experimental aquaria is of the same order as that in nature and considered to be accountable for meristic variability in certain species of fishes.

An effort was made to keep constant all environmental factors other than temperature, although undoubtedly there were secondary effects introduced due to the temperature differential. The aquaria were provided with "seasoned" water and were planted initially with nearly the same complement of water plants, mostly *Sagittaria*. Pond snails, both *Physa* and *Planorbis*, were plentiful. Supplementary air, introduced by means of a small electric pump, was regulated by needle valves and entered the water through an air-stone. The aquaria were kept in a dark-room, and uniform light was provided 24 hours a day by two 25-watt incandescent bulbs. The volume of water was the same in both tanks, and to the extent that water evaporated, aged tap water was added. The pH, tested colorimetrically, remained close to 7.6 throughout the course of the experiment.

The young fish used in the experiment were born on the morning of March 23, 1946. The temperature of the aquarium at the time was approximately 23° C. On March 25 half of the brood was placed in each aquarium. The intention was to supply food in maximal quantity to both tanks. Prepared, dry "tropical fish food" was powdered and given as often as twice daily. The kind of live food was determined by the available supply, and the quantity by the amount that would not foul the water. Somewhat greater amounts were given to the fish in the warmer tank B because of the higher metabolic rate to be expected at a higher temperature. Pond plankton, white worms, scraped beef, *Artemia* nauplii and later the adults, served as sources of fresh protein. To what extent small fish also served this purpose is unknown. The first newly born fish of a second generation were noticed in tank A in the twenty-first week. No newly born fish were seen in the warmer tank until after the termination of the experiment, when a single pair of adults was left and produced young.

Food as a factor in the environment was further complicated by the initial higher mortality in the warmer tank B (Table II), and recruitment in the population of tank A. After the appearance during the fifth month of young in tank A, equal quantities of food were given to the two sets of fish. Each month when fish were measured the new recruits were removed from tank A.

Development of such inequalities in the two populations due to effects of mortality and recruitment might also affect space as a limiting or controlling factor in the two environments.

Measurements of the two sets of fish were made at monthly intervals from the first to the nineteenth months. Fish were anaesthetized in a weak chlore-

tone solution of 1:2,500 concentration, recommended by Dr. Frederick Fish as relatively non-toxic. Fish were left for two or three minutes in this solution, or until quiescent, and were then removed with a small dipper to a metal measuring trough. This trough, designed and loaned by Dr. Willis H. Rich of Stanford University, had a vernier scale which permitted measurement to the nearest 0.1 mm. of total length. The fish were then transferred to a small net, where the remaining solution drained off, and returned to their tanks.

Inaccuracies in measurement, due to personal error, undoubtedly occurred. Other inaccuracies were sometimes caused by muscular contraction of a fish that interfered with its lying perfectly flat in the measuring trough.

SEX RATIOS

Sexes were ascertained as far as possible, at the time of measuring. Secondary sex characters began to appear as early as the second month, and were clearly evident in the fourth month; by the sixth month nearly all fish were apparently mature. Previous to the time when sexes were readily distinguishable, probable sex groupings were approximated by extrapolating growth curves of individual fish. Sex ratios in both tanks showed early predominance of males, although by the ninth month in the warmer tank B, and somewhat later in tank A, the percentage of males became less than that of females (Table I). The ratios continued to be higher for females in both tanks.

TABLE I
SEX RATIOS OF *Platyopocilus* IN TANKS A AND B, 1945 BROOD

Months	Tank A				Tank B			
	Males		Females		Males		Females	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
4	10	45(67)*	5	23(33)*	10	62	6	38
5	13	59	9	41	9	60	6	40
6	11	55	9	45	8	57	6	43
7	9	50	9	50	8	57	6	43
8	9	50	9	50	7	54	6	46
9	9	50	9	50	4	40	6	60
10	..	..	..	..	..	..	..	..
11	6	40	9	60	4	40	6	60
12	6	43	8	57	4	40	6	60
13	6	43	8	57	3	33	6	67
14	6	43	8	57	3	33	6	67
15	6	43	8	57	2	29	5	71
16	5	45	6	55	2	33	4	67
17	4	44	5	56	2	40	3	60
18	4	44	5	56	2	40	3	60
19	4	44	5	56	2	40	3	60

* Percentages in parentheses are of those individuals sexed; among the 4-month fish in tank A, 7 fish (32 per cent) were immature and not sexed.

ESTIMATES OF GROWTH OF INDIVIDUALS

As soon as individuals could be sexed it was possible to follow with a reasonable degree of certainty the subsequent growth of a particular fish. Lines

connecting a series of measurements would approximate the course of individual growth. Previous to the time when sex could be ascertained, however, the probable course of growth was estimated by connecting the earlier most likely measurement, representing the "best guess" for each individual. Such extrapolation of individual curves was made back to the fourth month. By this means it was possible to follow the growth of those individuals which survived throughout the course of the experiment, and thus to obtain a closer approximation to a "true" growth curve for each sex. The advantages in avoiding effects of mortality on later measures of mean growth were felt to outweigh the obvious difficulties in such estimates.

MEAN GROWTH AND VARIABILITY

Table II presents the data on variability in total length of fish (males and females combined) in the two tanks. Additional data on platy variability are given in Table III for a small brood (born on November 15, 1945) of the same genetic strain, kept for 18 weeks in tank B before the large brood was obtained. The coefficient of variation is considerably less for the small brood and may be associated with early selective mortality. The larger brood was born under conditions that probably favored maximal survival, i.e., when live

TABLE II

VARIABILITY IN TOTAL LENGTH OF *Platypoecilus* IN TANKS A AND B, MEASURED AT MONTHLY INTERVALS, 1946 BROOD

Months	Number of fish		Mean length (in mm.)		Standard deviation of combined lengths of the sexes		Coefficient of variation (in %)	
	Tank A	Tank B	Tank A	Tank B	Tank A	Tank B	Tank A	Tank B
1	22	18	18.1	17.8	3.35	2.40	18.5	13.5
2	22	17	26.7	25.4	5.00	3.35	18.7	13.2
3	..	..	....	....	....	....	....	....
4	22	16	31.4	29.4	4.45	4.20	14.2	14.3
5	22	15	32.4	30.7	4.80	4.05	14.8	13.2
6	20	14	33.1	31.6	4.95	4.30	15.0	13.6
7	18	14	34.1	32.3	5.30	4.45	15.5	13.8
8	18	13	34.8	32.8	5.55	5.00	16.4	15.2
9	18	10	35.6	35.2	5.70	5.30	16.0	15.0
10	..	..	....	....	....	....	....	....
11	15	10	38.2	37.2	5.30	5.60	13.9	15.0
12	14	10	38.4	38.3	5.20	5.90	13.5	15.4
13	14	9	39.0	38.3	5.35	6.30	13.7	16.4
14	14	9	40.0	38.5	6.00	6.40	15.0	16.6
15	14	7	40.7	39.5	6.30	6.40	15.5	16.2
16	11	6	41.2	39.8	6.80	5.95	16.5	14.9
17	9	5	42.1	38.1	6.40	6.00	15.2	15.7
18	9	5	42.5	38.4	6.45	6.25	15.2	16.3
19	9	5	42.7	38.6	6.75	5.80	15.8	15.0

pond food was abundant in the tank and the chances of being eaten by the parents were small.

From the average of individual measurements, mean growth curves were estimated (Fig. 1) for all males and females in each tank. Estimates for standard deviations (S) of the average length of each sex at each month of life were

made using Snedecor's (1948) table of ratios, range/ σ . A further estimate of standard error ($S\bar{x}$) was then used together with a table for values of t (reprinted in Snedecor, *op. cit.*) to obtain the confidence limits of these means at the 5 per cent level of probability. Some aberration in these curves is attributable to mortality of certain individuals; for example, loss of a particularly large male or female is reflected in a marked drop in mean sizes thereafter.

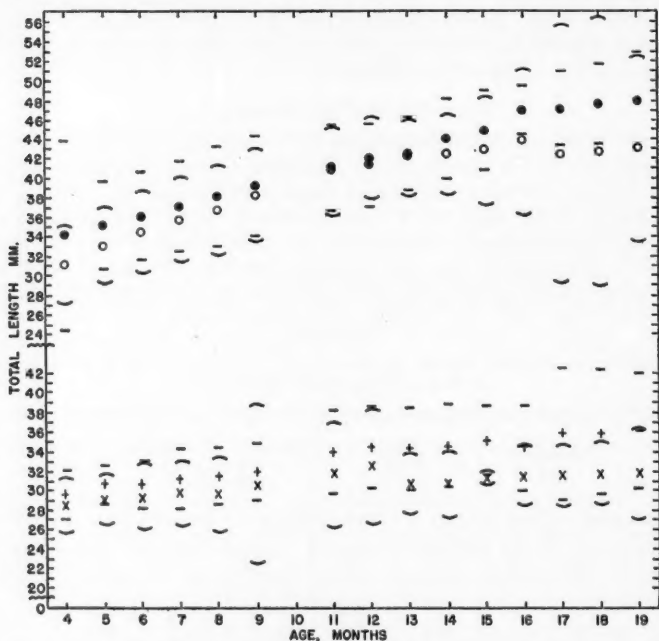


Fig. 1. Average size at the end of each month of life of females shown by * for tank A, by ° for tank B; of males shown by + for tank A and by X for tank B. Confidence limits for tank A means indicated by =, for tank B by O.

In order to avoid such effects of mortality on descriptive measures of growth in the two sets of platies, growth from the fourth month of only those males and females which survived to the end of the experiment is plotted (Figs. 2 and 3). The higher mortality of males results in a measure of male growth in tank B being based upon only two individuals. However, this is the best measure obtainable.

APPLICATION OF WALFORD'S METHOD OF TRANSFORMATION TO THE GROWTH CURVES OF *Platypoecilus*

It may be useful to know for comparison within fish stocks of commercial importance what order of variability in growth characteristics is found within

one genetic strain of a species when comparable groups are subjected to some alteration in their physical environments.

The growth characteristics of one genetic strain of platies exhibit striking stability with respect to rate of deceleration of growth (k) as shown in the

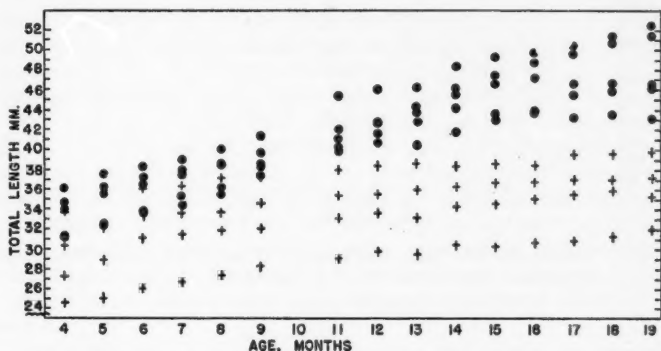


Fig. 2. Lengths from the fourth month of life of males and females which survived to the end of the experiment in tank A. Males indicated by +, females by •.

TABLE III

VARIABILITY IN TOTAL LENGTH OF *Platyopocilus*, MEASURED AT WEEKLY INTERVALS, 1945 BROOD

Weeks	Number of fish	Mean length (in mm.)	Standard deviation of combined lengths of both sexes	Coefficient of variation (in %)
2	13	11.8	0.36	...
3	13	13.6	0.34	...
4	13	15.0	0.56	3.7
5	..	....	....	...
6	..	....	....	...
7	10	17.5	0.66	...
8	10	18.7	0.70	3.7
9	10	20.4	0.54	...
10	10	22.3	1.07	...
11	10	24.6	1.00	...
12	10	26.5	1.03	3.9
13	10	27.9	0.95	...
14	10	29.0	1.16	...
15	10	30.0	1.25	...
16	10	31.0	1.39	4.5
17	10	31.8	1.36	...
18	10	32.6	1.80	...

slopes of the following regressions. At the same time there is wide latitude of variation in absolute size at any age, and in the males as compared with females, as well as some variation in their asymptotic limits of growth. This contrast in

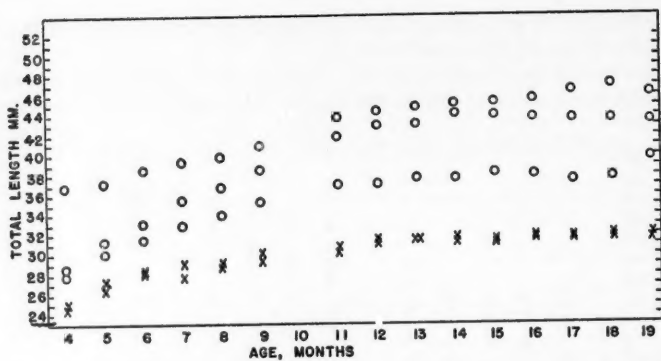


Fig. 3. Lengths from the fourth month of life of males and females which survived to the end of the experiment in tank B. Males indicated by X, females by O.

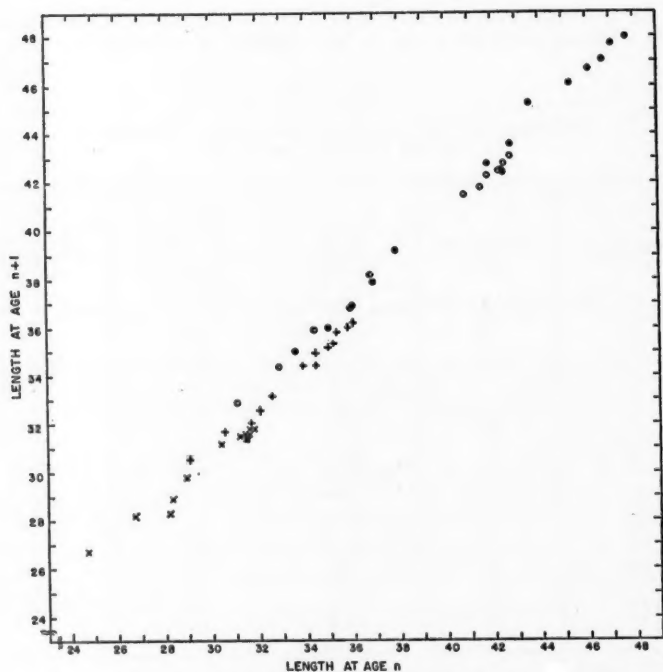


Fig. 4. Transformations of the mean curves of growth of males and females surviving to the end of the experiment. Average sizes of males in tank A indicated by +, females by •. Average sizes of males in tank B indicated by X, females by O.

plasticity with relative stability in the growth characteristic (k) suggests that phenotypic variability may prove to be distinguishable from genotypic difference.

Figure 4 shows transformations of the curves of growth for the fish in tanks A and B. The points plotted are the mean lengths of those males and females that survived to the end of the experiment. These curves illustrate the relative constancy in rate of deceleration of growth expressed by the slope of the regression line. Regardless of actual size attained at any given age, the percentage increments in successive equal time periods show the constant ratio of a geometric series. Thus, although females grow much faster than males and probably achieve a considerably greater length, the percentage ratio that each increment represents of the one preceding is closely similar for both sexes. This relation also holds in comparing fish of lesser mean absolute sizes at any given age (whether males or females) in the warmer tank with those of greater size in the cooler tank. The rate of deceleration remains nearly the same and variability in absolute size is expressed, as in males and females in one tank alone, by difference in position along the more or less constant regression slope.

Such minor differences as do exist in these two pairs of transformations (Table IV) may be associated in some degree with the small, relatively constant temperature difference in the two tanks. Both males and females in the warmer tank show somewhat more rapid rates of deceleration and lower asymptotic limits of growth. Unfortunately no comparable control tanks were available to further check these effects, and no measure of variation due to chance alone was obtained.

Transformations of growth curves for individual fish follow a geometric progression rather closely. Growth of four platies, the smallest and largest of the males and of the females that survived throughout the whole period of observation in tank A, is plotted in Fig. 5. Again, despite widely differing absolute values, the ratio of successive increments remains nearly the same. The four curves together trace an almost straight line and further illustrate the relative stability of the growth characteristic k .

Two small broods of platies of the same genetic strain as the large brood were maintained for a short period in the same tanks A and B, and supplement the data of the main experiment. Six fish were born October 8, 1945, in tank B; thirteen were born November 15, 1945, in tank A. The latter brood was reduced to ten due to an accident that occurred in both tanks in December. Except for this interval when fish were transferred to other tanks, they were measured weekly beginning with the first week in tank B, the second week in tank A. Temperature conditions were similar to those prevalent during the period of experiment with the large brood but with less difference in the temperature levels in the two tanks. The small broods were given a somewhat different diet from that of the large brood as the attempt was not made to supply food in maximal amount.

Mean growth curves for males and females combined are shown in Fig. 6 for the two small broods as compared with the two halves of the larger brood. Differences in the first stages of growth may be attributed largely to the lesser food supply available to the smaller broods.

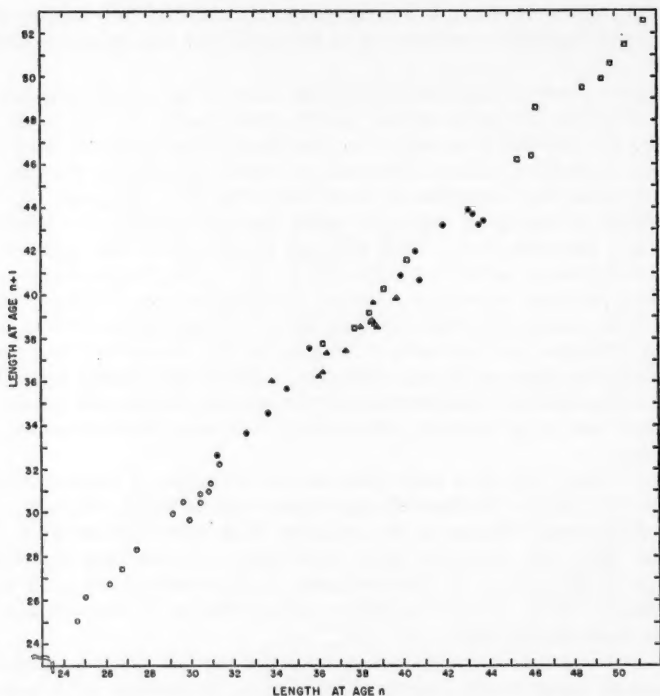


Fig 5. Transformations of growth curves of the smallest and largest male and female individuals that survived to the end of the experiment in tank A. Smallest male indicated by \circ , largest male by Δ , smallest female by $*$, largest female by \square .

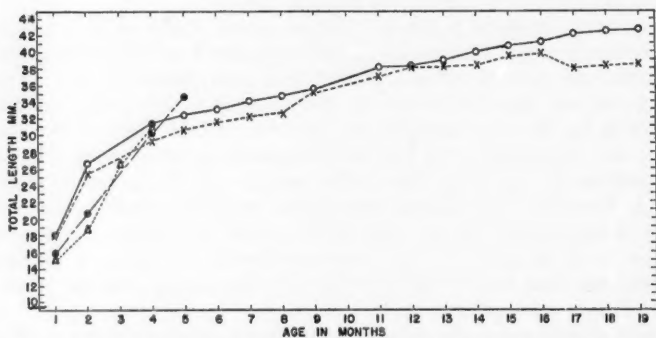


Fig. 6. Mean growth curves of *Platypocilus maculatus*, males and females combined. Average sizes of half of the large brood in tank A shown by \circ , of the half in tank B shown by \times . Average sizes of a small brood of six shown by $*$, of another small brood of ten shown by Δ .

When average growth for all three broods is plotted in transformations (Fig. 7), mean growth for males and females combined suggests a similar percentage rate of deceleration in the small broods and in the two sets of the larger brood. The constancy of slope maintained in different environments seems to indicate that the growth characteristic k is a genotypic character, while differences in the level of these transformation lines probably represent phenotypic variation. In the large brood, mean growth beyond the inflection point is represented satisfactorily by the transformation curve. The deviation of the first points from these two regressions indicates that the transformation cannot be applied to that part of the usual growth curve below the inflection. (Transformations in Figs. 4 and 5 include only sizes subsequent to the first

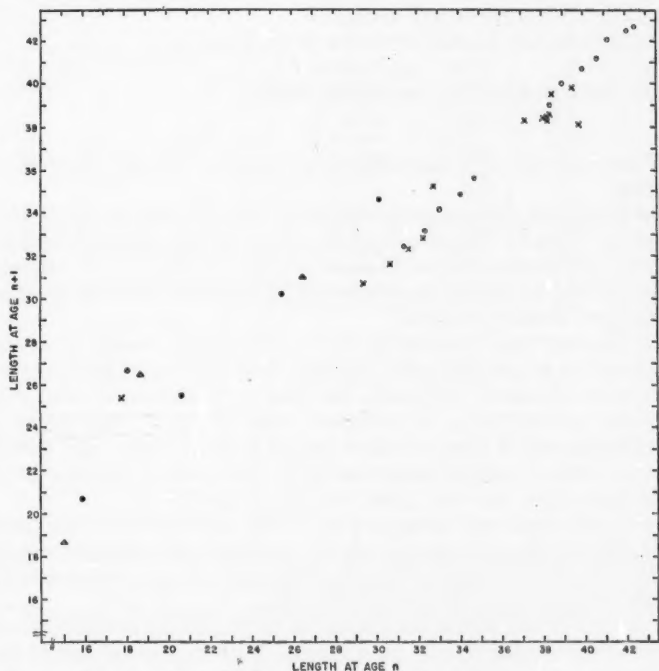


Fig. 7. Transformations of mean growth curves shown in figure 6.

period of rapid growth.) For the two small broods maintained only until weeks 18 for one, and 23 for the other, mean growth is plotted by the 4-week time interval equivalent to that used for the larger brood. It is not clear from either the conventional plot (Fig. 6) or the transformation (Fig. 7) at what time the inflection point of the length-on-time curves appears for the small broods. When, however, such curves are plotted showing weekly, rather than monthly, increments in size there is an indication that for smaller broods inflection occurred at an earlier age so that their transformations properly may be compared with those of the two sets from the larger brood.

CALCULATED GROWTH CHARACTERISTICS

Walford (*op. cit.*) suggested that the growth characteristics k and l_{∞} could be used for studying growth variation within and between populations, and hence for distinguishing between races of animals with differing growth patterns.

In commercially important species, individuals often do not become fully available to the fishery until after they have passed the point of inflection. In populations of food fishes the growth characteristics may be derived (from calculated lengths of fish) without recourse to graphic treatment, and are provided, in effect, from a fit of the linear regression of lengths at ages $n + 1$ on n . The two constants for the linear equation of the type $y = a + bx$ were obtained by the method of semi-averages.²

This is equivalent in Walford's notation to the equation,

$$l_{n+1} = l_1 + k l_n$$

and also yields an estimate of asymptotic length,

$$l_{\infty} = \frac{l_1}{1-k}$$

These constants are then applicable to the phase of growth following the inflection.

The two growth characteristics, deceleration rate (k) and asymptote (l_{∞}), are given in Table IV. These were calculated for average growth of each sex, for certain individuals, and for the sexes combined, in the two sets of platies discussed above. For the two small broods growth characteristics are estimated for males and females combined.

For the larger brood the small calculated ultimate size of males reflects the sex dimorphism in size observable in platies from the time of appearance of secondary sex characters. In general, the rates of deceleration are also somewhat more rapid in males. An inhibitory effect of higher temperatures on growth is suggested in lesser symptotic lengths as well as more rapid deceleration rates for both sexes in the warmer tank. The two small broods show the slowest deceleration rate and highest calculated ultimate size.

Asymptotic levels vary widely and are sometimes improbably high for the species. Deceleration rate, however, is the growth characteristic showing the most stability, varying only within rather narrow limits, as is revealed also in the graphic treatment of the platy growth data.

It was found both for the platy data and for the growth characteristics of one year-class of pichard that when growth characteristics are plotted as a regression of asymptotic length on slope, the relationship is curvilinear rather than rectilinear. The values for asymptotic length increase very rapidly at the higher values of k when rate of deceleration in growth is very slow.

CONCLUSIONS

Irrespective of the initial period of rapid growth, it appears that beyond the inflection point the rate of deceleration of growth, as shown by the slope of a

² This method in lieu of "least squares" was recommended by Dr. Walford for use in calculating growth characteristics of pichard from scale data. Aside from its simplicity when applied to large numbers of individuals, the method may have an additional advantage in that, if the first point in the transformation curve were sometimes influenced in a non-random manner, owing to possible inclusion of a segment of the growth curve preceding the inflection point, the effect would be minimized.

transformation line, is relatively constant for this genetic strain of platies. Within the limits of the experiment the rather consistent slopes or deceleration rates hold, both for different metabolic rates as under slightly different tem-

TABLE IV
GROWTH CHARACTERISTICS OF THE TRANSFORMATIONS OF THREE
BROODS OF *Platyopocilus maculatus*

Brood and Measurement	Tank	Sex	Slope k	Y-intercept	Asymptote
3/23/46 brood of 45 fish; growth measurements from the 4th to 19th month Transformations of:—					
Mean lengths of all individuals	A	Male	0.92	3.2	38.6
		Female	0.99	1.5	107.0
	B	Male	0.72	8.8	31.6
		Female	0.84	7.1	44.4
Mean lengths of individuals which survived to end of experiment	A	Male	0.88	4.7	37.6
		Female	0.95	3.0	60.0
	B	Male	0.79	6.7	31.6
		Female	0.83	7.3	44.0
Lengths of 4 selected individuals which survived to end of experiment	A	Male #1	0.94	2.1	37.5
		Male #4	0.83	6.6	39.8
		Female #1	0.89	5.0	45.6
		Female #5	0.96	3.1	68.8
Mean length of all individuals	A	Male and female	0.92	3.7	46.3
	B	Male and female	0.85	6.1	40.1
10/8/45 brood of 6; growth measurements from the 1st to 23rd week					
Transformations of mean lengths of all individuals	B	Male and female	0.99	1.3	162.5
11/15/45 brood of 10; growth measurements from the 2nd to 18th week					
Transformations of mean lengths of all individuals	A	Male and female	1.00	1.3	l_{∞}

perature conditions, and in different sexes and, in all probability, at different levels of food intake as well. The growth characteristic k thus may be useful as a physiological character descriptive of a population of fishes.

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U. S. FISH AND WILDLIFE SERVICE, JORDAN HALL, STANFORD, CALIFORNIA.

Notes on Marking Live Fish with Biological Stains¹

By ARNOLD DUNN and COIT M. COKER

ALL methods of tagging or marking live fish now being employed have one or more disadvantages, for example: (1) The tag may be rejected later by the fish, or the mark may be obscured by later growth. (2) The marking may be overlooked by the observer, as with clipped fins. (3) The tag is not practical to use with fish below a certain size limit. (4) Handling procedure inherent in the tagging method may either injure the fish so as to cause aberrant behavior, or be accompanied by a high rate of mortality. (5) The marking method may require elaborate equipment, unwieldy for use in the field, as in tattooing.

No one tagging method circumvents all of these and still other difficulties. Believing that the use of dyes might provide the solution to some of these problems, experiments were begun at the Chesapeake Biological Laboratory during the summer of 1949 in an effort to develop effective dye-marking procedures.

Kask (1936) and Woodbury (1948) reported the successful use of India ink, applied by hypodermic and electric tattoo needle, respectively. In both methods the black ink was applied to a white or light-colored surface. Black markings, however, are easily overlooked on dark backgrounds; thus dyes of other colors were employed exclusively in this study. The first step was to determine which biological stains would be tolerated by fish tissues. An injection technique was employed and twelve stains were tried.

Killifishes (*Fundulus heteroclitus*, *F. majalis*), abundant locally, were used in all of the experiments. Small numbers of young spot (*Leiostomus*

¹ Contribution No. 86 from the Chesapeake Biological Laboratory, Solomons, Maryland.

xanthurus), young croakers (*Micropogon undulatus*), young striped bass (*Morone saxatilis*), and young white perch (*Morone americana*) also were used. The first fish tested were kept in small indoor aerated aquaria, but it was soon found better to keep them in 2' x 2' x 2', screenwire-bottomed live boxes staked out in the Patuxent River, adjacent to the Laboratory, where conditions were more natural. No more than 10 experimental fish were kept in any one box.

Injectations were made with a 0.25-cc. tuberculin syringe fitted with a size No. 27 needle. The needle point was inserted into the dorsal region directly anterior to the caudal fin, then pushed forward into the tail muscles above the vertebral column (Fig. 1). It was not always possible to measure the exact amount of stain injected, since some of it usually leaked back through the small puncture made by the needle. When the stain appeared in the musculature to the extent of area I (see Fig. 1), injection was stopped. The amount injected varied with the size of the fish, but never exceeded 0.25 cc. Unless indicated otherwise, all test injections were of 1 per cent solutions of stain in

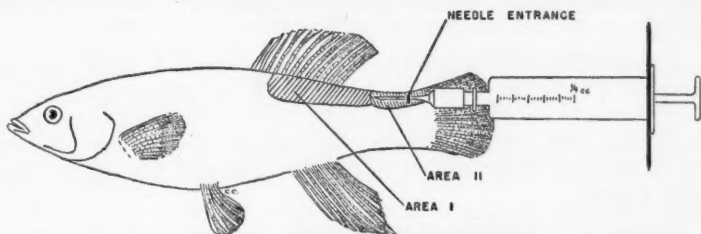


Fig. 1. Site of injecting live fish with stain.

distilled water (Fast Green, Bismarck Brown Y, and Janus Green B) or in 0.85 per cent NaCl (all other stains).

Two separate controls were used in all experiments. Several fish were left uninjected in the same aquarium or live-well; others were injected with 0.85 per cent solution of NaCl. Their entirely normal behavior subsequently indicated that neither the method of injection nor captivity in the live-boxes was having detrimental effect on the experimental animals. All stains used were those standardized by the Biological Stain Commission at Geneva, New York.

Fast Green.—Ten killifish were injected, and in 3 hours the stain had spread all over the body, giving the animal a distinctive green tinge. This condition lasted 10 to 14 hours. Dissection of five fish, 4, 5, 6, 7 and 8 hours after injection, showed that all internal organs and muscles were green. Quantities of stain were seen in the kidney tubules. After 14 hours, the remaining five animals had lost all color except a patch at area II (Fig. 1) which persisted for 6 days and then began to fade. The patch was not visible 8 days after injection.

Bordeaux Red.—Fifteen killifish were injected. Local inflammation was noticed at the place of injection one day later. Two days after injection nine of the fish were dead and the remainder died within the next 24 hours. A

large, spongy, ulcer-like spot could be seen on each fish where the first inflammation occurred.

Bismarck Brown Y.—Six killifish were injected and within 24 hours the scales at the site of injection became eroded; that is, they became more or less erectile, and loosened, compared with the surrounding scales. Death followed within 30 hours after injection. Smaller dilutions of the stain were not tried.

Janus Green B.—Four killifish were injected. Scale erosion was seen in 24 hours, and all of the fish were dead 32 hours after injection. Smaller dilutions were not used.

Alizarin Red S.—Six killifish, one striped bass, and three spot were injected. Color remained in the tail muscles without immediate injurious effect. Two days later the dye was seen in the caudal rays, but the scales in the caudal region were eroded and the flesh exposed. Three and one-half days after injection, all of the fish were dead. The caudal rays of all of the fish were noticeably stained. Smaller concentrations of this stain did not show up well.

Brilliant Cresyl Blue.—Eight killifish were injected. A partial paralysis of the tail muscles developed almost immediately and persisted for about 2 hours. The tail was bent at an angle of 90° to the body, and swimming was accomplished with difficulty. Five minutes after injection, the blue color was seen at the bases of all fins and on the operculum and gills. All fish died within 5 hours.

Trypan Blue.—This was the most successful stain used. Two white perch, two croakers and eight killifish were injected. Three killifish held the stain in area II; in the remaining killifish, the dye spread over areas I and II. The white perch held the stain in areas I and II and the color also spread ventrally and was seen very plainly between the pelvic and anal fins. The croakers held the stain in area II. The color was clearly seen in all fish on the seventeenth day. Unfortunately, the live-box containing the injected fish was lost in a storm when the experiment was 18 days old.

In a repetition of the experiment, five killifish were injected. Four fish held the stain in area II; in the fifth animal, the stain spread over areas I and II. At 6 weeks, the color was still plainly visible.

Trypan Red.—Trypan Red, injected into six killifish, gave a reaction very similar to that of Trypan Blue. However, the orange-red color did not show up clearly, although it could be seen in area II after 4 weeks.

Methyl Violet.—Four killifish were injected and the color spread rapidly into areas I and II, and into the dorsal fin. However, within 24 hours, inflammation in areas I and II was evident. All the fish died within 48 hours after injection. Smaller concentrations of the stain (0.25 per cent and 0.15 per cent) did not show up well, and killed more rapidly—causing death within 2 hours.

Safranin O.—Five killifish were injected. The color remained in area II. Inflammation was observed in 18 hours, and the animals died 24 hours after

injection. Smaller concentrations ranging from 0.5 per cent to 0.25 per cent killed in 5 hours.

Congo Red.—Three killifish and one striped bass were injected. The dye remained in area II in the killifish and spread all over the striped bass. After 2 days, the scales at area II were eroded in all fish, and on the third day all the fish died. Smaller concentrations, ranging from 0.5 per cent to 0.25 per cent, killed much more rapidly, usually within one or 2 hours.

Methylene Blue.—Four killifish were injected. The color remained plainly visible at areas I and II for 14 hours, but then proceeded to fade. In 36 hours after injection there was no visible trace of the stain.

CONCLUSIONS AND DISCUSSION

Of the stains tested in this preliminary experiment, Bordeaux Red, Bismarck Brown Y, Janus Green B, Alizarin Red S, Methyl Violet, Safranin O, Brilliant Cresyl Blue, and Congo Red were lethal. The lethal effect was more rapid with lesser concentrations (less than 1 per cent) of Methyl Violet, Safranin O, and Congo Red. Fast Green, Trypan Blue, Trypan Red, and Methylene Blue were non-lethal over the period of the test. Brilliant Cresyl Blue exerted a partial paralytic effect on killifish for about 2 hours.

The behavior of Fast Green suggests its use as a marker for small fish such as minnows in population studies of extremely short duration (e.g., in school behavior, or following local movements in a restricted environment, etc.). In clear water, it might be possible to observe the movements of marked fish without necessitating recapture.

The dye showing greatest promise for permanent or semi-permanent marking was Trypan Blue. Its usefulness will be extended when a suitable method of applying symbols is worked out.

Some differences in response to the dyes by different species of fishes were observed. Consequently, no general statements about the applicability of dyes can be made with assurance until further experiments have been performed with a wider variety of dyes and of fishes, and with other techniques of application. Feeding of dyes and total immersion in dyes are additional techniques which should be tested. Students of animal behavior would undoubtedly welcome methods whereby fish could be marked, even temporarily, with little or no handling. We may say that the general field of dye-marking appears to offer some promise in this direction and that the surface barely has been scratched. There is also the possibility that some dyes could be used to mark fry and young fingerlings so that they would be distinguishable at later growth stages.

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BIOLOGICAL LABORATORY, SOLOMONS, MARYLAND.

A New Eel of the Genus *Taenioconger* from the Philippines

By J. BÖHLKE

WHILE looking over various undetermined fishes in the Natural History Museum of Stanford University, the writer discovered two specimens of Heterocongridae, a family of eels that is very rare in museum collections. These specimens were collected by Dr. A. W. Herre in 1940 and represent an unknown species of the genus *Taenioconger* which he described as new in 1923.

Taenioconger naeocepaeus, sp. nov.

HOLOTYPE.—Stanford No. 16052, collected by Dr. A. W. Herre at Patalon, Zamboanga Province, Mindanao, Philippines, August, 1940.

PARATYPE.—One specimen, Stanford No. 16051, 285 mm. in total length, with same data as holotype.

DESCRIPTION.—Measurements of holotype in millimeters: total length 304; head and trunk 117.5; tail 186.5; depth of body 4.2; head 16.5; eye 3.4; snout 2.5; bony interorbital 0.8; gape 3.8; length of gill opening 1.3; tip of snout to dorsal origin 16.8; pectoral length 2.2.

Body excessively elongate, nearly round in cross section anteriorly, becoming more compressed toward the end of the tail. Anus in anterior half of length. (Proportions for paratype are given in parentheses, in the following.) Head and trunk contained 1.6 (1.6) in tail. Greatest depth of body 72.4 (73.1) in total length, 3.9 (3.8) in head. Head 18.4 (19.0) in total length. Eye large, longer than snout, 4.9 (4.5) in head. Snout narrow, with nearly parallel lateral margins, its length 6.6 (6.0) in head, 1.4 (1.3) in eye. Bony interorbital very narrow, its least width 20.6 (18.8) in head, 4.3 (4.1) in eye, 3.1 (3.1) in length of snout. Gape very oblique, extending to, or slightly beyond, the front border of the pupil, its length 4.3 (4.2) in head. Lower jaw projecting slightly beyond snout.

Teeth on jaws small, sharp, closely set; upper jaw with a narrow band three or four teeth wide anteriorly, progressively reduced to a single irregular row posteriorly; dentition of lower jaw similar but the band not more than three teeth wide anteriorly; both jaws with enlarged canines at the rear, these abruptly larger than the preceding teeth in the holotype, grading into the regular series in the paratype. Vomerine series composed of an anterior patch of eight or nine close-set teeth, merging into a more or less uniserial median line of four or five more widely spaced teeth, and expanding posteriorly into an enlarged patch. All teeth in the vomerine series larger than those on jaws. The patterns, rather than the actual numbers of teeth, appear to be important in distinguishing species in this genus, as the paratype has a more reduced dentition. In the paratype there are fewer jaw teeth, a more regularly uniserial vomerine series, and no posterior vomerine patch. Tongue free.

Both pairs of nostrils on anterior half of snout. The anterior portion of the snout is damaged on both specimens so it is possible that the anterior nostrils were tubular, but they exist on the present specimens as two small openings projecting horizontally forward at the tip of the snout. The posterior

nostrils are nearly horizontal slits immediately behind the anterior ones and slightly more lateral in position. Flanges on lips partially damaged but clearly not as extensive as those of *T. digueti* Pellegrin and *T. herrei* Wade. Postorbital region of head comparatively long, supported by an indeterminate number of jugostegalia (Parr, 1930: 71), some of which are clearly visible through the skin of the branchial region. The longitudinal folds of skin in the postorbital region of the head, so outstanding in *T. digueti* and *T. herrei*, are scarcely evident in this new form. Gill openings at about middle of sides, almost perfectly rounded anteriorly, their width nearly twice base of narrow pectoral fin, 12.7 (11.5) times in head.

Dorsal fin beginning over base of pectorals (slightly more posteriorly on the paratype, but its vertical still within reach of the fin when appressed), continuous, evidently rather high, as some of the posterior rays are more than half as long as the body is deep. Anal fin inserted immediately behind anus, the individual rays becoming slightly longer on the compressed posterior portion of the tail. Vertical fins confluent around the pointed tail as a very short

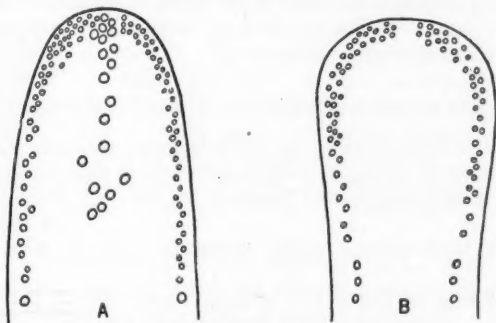


Fig. 1. Dentition of the holotype of *Taenioconger naeocephalus*.
A—Upper jaw; B—Lower jaw.

fringe of rays, covered by skin, the condition resembling that found in *Myrus uropterus* (Schlegel). Pectorals of approximately 12 rays, situated at the dorsal end of the gill openings, very short, their length 7.5 (7.1) in head, 1.5 (1.6) in eye.

Lateral line complete, continuous with the canal system of the head. Pores of lateral line very small and quite widely spaced, 40 counted on holotype, beginning with the first pore just posterior to the junction of the lateral line proper and the supratemporal canal and ending with the last pore anterior to a vertical through the anus. On each side, the supraorbital canal opens by two pores on the interorbital space just above the eye and, continuing forward, is marked by two additional pores on either side of the snout. The suborbital canal displays three pores along the posterior margin of the eye, two pores below the eye, and then continues forward beneath the flange of the upper lip to the tip of the snout.

Taenioconger naeocephalus differs from *T. chapmani*, the other species known from the Philippines, in possessing a more extensive gape, different

vomerine dentition, a much shorter tail, a longer head, and in other body proportions. This new form further differs from all three of the previously described species of *Taenioconger* in the nature of the caudal fin. In the other species, the posterior dorsal and anal rays are high and confluent with a well developed caudal, giving the end of the tail a broadly rounded outline. In *T. naeoepeus*, however, the tail comes to a point posteriorly and the caudal rays form an extremely short fringe which is probably completely included by the skin of that region. This condition of the tail in the new form approaches that of the genus *Gorgasia*, which Meek and Hildebrand (1925: 133) described and called a derichthyid. The extremely elongate body (much more so than for any other described derichthyid), the origins of the vertical fins, and the general features of the head and branchial region of *Gorgasia* help support a probability that it and *Taenioconger* may belong to the same family, and possibly the same genus. If future work shows *Gorgasia punctata* to be a heterocongrid, yet not congeneric with *Taenioconger*, then *T. naeoepeus* will become *Gorgasia naeoepeus*.

With four species now described in the genus, it appears advisable to present a key for their determination. Since the entire family is so poorly known, this key will obviously not be a natural one.

KEY TO THE SPECIES OF THE GENUS *Taenioconger*

- 1a. Vomerine teeth arranged in two uniserial rows, separated medially by a free space except where they divide anteriorly or unite again posteriorly; head 12 in total length (San Francisco Id., Gulf of California) *T. herrei* Wade 1946
- 1b. Vomerine teeth without median interspace; head 18 or more in total length.
 - 2a. Tail long, its length 2.0–2.8 times length of head and trunk combined; vomerine teeth in a dense triangular patch.
 - 3a. Gape extending to or beyond front margin of eye; lower jaw longer than snout; gill opening above middle of side (Espiritu Santo Id., Gulf of California) *T. digueti* Pellegrin 1923
 - 3b. Gape not extending to front margin of eye; lower jaw same length as snout; gill opening situated at middle of side (Dumaguete, Philippines) *T. chapmani* Herre 1923
 - 2b. Tail short, its length 1.6 times length of head and trunk combined; vomerine teeth not in triangular patch, median vomerine series irregularly uniserial (Mindanao, Philippines) *T. naeoepeus* sp. nov.

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NATURAL HISTORY MUSEUM, STANFORD UNIVERSITY, CALIFORNIA.

Notes on the Dolphin (*Coryphaena hippurus*) in North Carolina Waters

By HOWARD A. SCHUCK

DURING cruises of the U. S. Fish and Wildlife Service's research vessel "Albatross III" in waters off North Carolina, an opportunity was afforded to collect dolphin (*Coryphaena hippurus*) and to record certain data concerning them. This species, also called dorado, was taken incidental to the main work of investigating the bottom fisheries of this area.¹

Although the number of specimens is small, it is thought that, considering the lack of biological information on this species, the data collected are of sufficient value to report.

METHOD OF COLLECTING DATA.—During much of the three weeks (May 19 to June 14, 1949) that the "Albatross III" was investigating the fishery off North Carolina, three lines with artificial lures (feather jigs) were trolled on the surface at a speed of about eleven knots, while en route to various stations. This trolling yielded the 19 specimens reported upon herewith.

The data collected for each fish were: length, weight, sex, and stage of maturity. In addition, gonads of females were preserved and notes were taken on stomach contents. Depth of water and the place of capture were also recorded for each specimen.

DISTRIBUTION.—The surface waters, which were trolled, ranged from areas as shallow as one fathom, near shore, to areas over 1,000 fathoms deep, well out into the Gulf Stream, and were between latitude 32°00' N. and latitude 36°00' N. This area includes most of the waters off the coast of North Carolina.

In addition to recording the locality of capture, the location where each dolphin was hooked but lost was also recorded. Other species were lost in smaller numbers, but most of the dolphin that were lost were distinguishable from other species. The latter included bonito (*Sarda sarda*); little tuna, false albacore, or little bonito (*Euthynnus alletteratus*); amberjack (*Seriola dumerili*); and what was tentatively identified as a blackfin tuna (*Parathunnus atlanticus*).

¹ These studies were undertaken jointly by the Institute of Fisheries Research of the University of North Carolina and the Fish and Wildlife Service of the U. S. Department of the Interior. This report appears by permission of both organizations.

The miles that were trolled on the surface (by three lines) in each of the various depth zones, as well as the number of dolphin caught, the number of fish thought to be dolphin that were hooked and lost, and the average number of miles per fish hooked, are shown in Table I. It can be seen that a considerable difference exists in the relative success of trolling over the different depth zones; it was most productive over the range of 21 to 100 fathoms, relatively unproductive over shoal water and the 101-1,000 fathom layer, and entirely unproductive over all depths greater than 1,000 fathoms (most of which were in the Gulf Stream).

TABLE I
MILES TROLLED, NUMBER OF DOLPHIN CAUGHT OR LOST, AND AVERAGE MILES PER
FISH HOOKED IN VARIOUS DEPTH ZONES

Depth zone (fathoms)	Miles trolled	Number of dolphin hooked and caught	Number of dolphin hooked and lost	Total number hooked	Average miles per fish hooked
0- 20	485	3	4	7	69
21- 50	270	11	14	25	11
51- 100	96	3	6	9	11
101-1,000	269	2	2	4	67
1,001-up	62	0	0	0	∞
Total, all zones	1,182	19	26	45	26

LENGTH AND WEIGHT.—The fork length in centimeters, weight in pounds, and sex of 18 of the fish (data not available for one) are plotted in Fig 1. The curve shown is of the type $y = ax^b$, and was fitted by means of least squares (Snedecor, 1940), using a logarithmic transformation. The equation is: $y = 0.0000144 x^{3.281}$, where y = weight in pounds, and x = length in centimeters. The average length of all the dolphin was 82.7 centimeters (32.6 inches), and the average weight was 11.4 pounds. Males averaged a little larger than females (85.7 cm. and 13.0 lb. versus 81.2 cm. and 10.6 lb.) but no difference in the weights of males and females of a given length could be observed in these limited data.

The average weight was estimated for various lengths (over the range from 40 to 120 centimeters) although it meant extrapolating somewhat beyond the limits of our observed data. These estimated weights, shown in Table II, cover sizes of the majority of dolphin caught. The world record for rod and reel is recognized as 67½ pounds, the fish taken by Fred McNamara off Oahu, Hawaii, August 19, 1940, (LaMonte, 1946), but relatively few are taken over 30 pounds.

FOOD.—Flying fish (*Cypselurus heterurus*), several partially digested tuna-like fish believed to be *Euthynnus alletteratus*, and remains of some species of crab were found in several stomachs, but most were empty.

AGE, MATURITY, AND FECUNDITY.—Scale samples of 18 fish were impressed on cellulose acetate and examined under a microprojector. Marks thought to be

annuli were found on some scales, but they were so indefinite that no reliable estimate of the age of these fish could be obtained. All fish that were observed (twelve females, six males) were sexually mature. Eggs were found in all

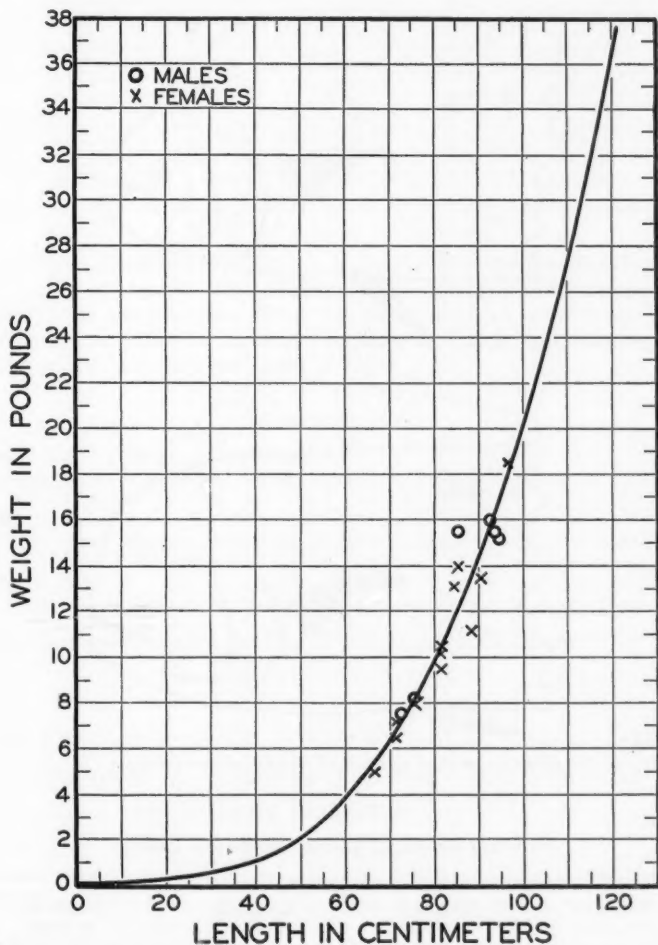


Fig. 1. Lengths and weights of 18 dolphin and calculated line expressing the length-weight relationship. Circles for males, crosses for females.

females and these eggs appeared to be almost ripe. No spent fish were taken.

Gonads were preserved from six of the twelve females taken. The number of eggs in each gonad was estimated by counting a number of samples—each containing one cubic centimeter—and applying the average number per sam-

ple to the total content. The total number of eggs, per fish and per pound of fish, is shown in Table III. The average for all six females was 2,655,500 eggs per fish or 252,000 eggs per pound of fish.

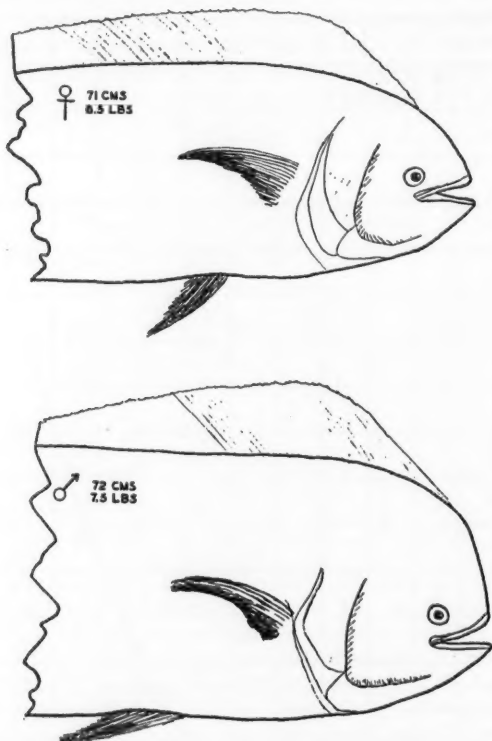


Fig. 2. The difference in form of heads of female and male dolphin.

TABLE II
ESTIMATED WEIGHTS OF DOLPHIN OF VARIOUS LENGTHS

Length in centimeters	Weight in pounds	Length in centimeters	Weight in pounds
40	1.0	85	11.9
45	1.5	90	14.3
50	2.1	95	17.1
55	2.9	100	20.1
60	3.9	105	23.6
65	5.0	110	27.3
70	6.4	115	31.7
75	7.9	120	36.6
80	9.8		

TABLE III
ESTIMATED NUMBER OF EGGS CONTAINED IN THE OVARIES OF DOLPHIN

Weight of fish in pounds	Number of eggs	Number of eggs per pound of fish
6.5	1,706,000	262,462
8.0	1,672,000	209,000
9.5	2,641,000	278,000
10.2	1,937,000	189,902
10.5	1,887,000	179,714
18.5	6,090,000	329,189

SEXUAL DIMORPHISM.—There is a decided difference in form between adult males and females. This difference is evident largely in the shape of the head (Jordan and Evermann, 1896). Outlines were traced of the heads of two of the dolphin: a 72.5-centimeter, 7.5-pound male; and a 71.5-centimeter, 6.5-pound female; and these are shown in Figure 2.

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A Taxonomic Study of the Ratsnakes, Genus *Elaphe* Fitzinger. I. The Status of the Name *Scotophis* *laetus* Baird and Girard (1853)

By HERNDON G. DOWLING

THE application of names in the North American snakes which are now placed in the genus *Elaphe* has long been a subject of dispute due to the similarity of characters which these snakes display. It is only recently that sufficient specimens of this genus have been available from which ranges may be outlined with some exactitude in the United States. Even now, however, there are few good series in collections and many areas are almost unknown herpetologically; but the amount of material that has accumulated in the past few years greatly exceeds that which other workers have had.

A study of the material now available has revealed an unfortunate mistake in identification in the Plains Ratsnake. The snake currently referred to as

Elaphe laeta (Baird and Girard) is a grayish or brownish form rather closely related to *E. guttata* (Linne), with brown, black-bordered blotches and with a head pattern which persists (although only faintly in very old individuals) throughout life. As shown below, the name *E. laeta* is misapplied and belongs in the synonymy of *Elaphe obsoleta* (Say).

The name *Scotophis laetus* Baird and Girard (1853: 77-8) was based on a specimen collected by Captains Marcy and McClellan during their exploration of the Red River (of the south). This is one of several species taken by the exploring party for which no exact locality data were noted and the type locality is given by Baird and Girard merely as "Red River, Ark." As shown by Dundee (1950: 55) the type locality may be more accurately restricted to southwestern Oklahoma or the eastern part of the Texas panhandle (Fig. 1).

The type specimen of *Scotophis laetus* appears to have been lost. However, the original description is clear and contains sufficient information to

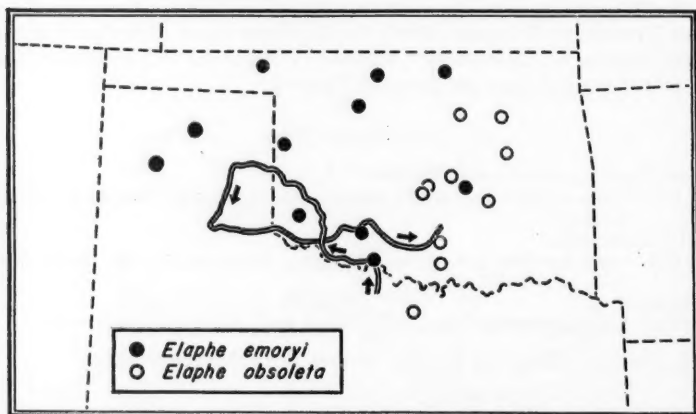


Fig. 1. Map of Oklahoma and northern Texas showing the exploratory route of Marcy and McClellan (= the restricted type locality of *Scotophis laetus*) and the localities from which specimens were examined for the present study.

allocate this name definitely to one of the two species of *Elaphe* which are now known to inhabit this area. In addition to the original description, which appeared in the *Catalogue of North American Reptiles* (January, 1853), the description was reprinted with a few changes of wording in Appendix F (by Baird and Girard) of the *Exploration of the Red River of Louisiana* (Marcy and McClellan, "1853" [sometime after November 10]: 227) and a figure of the type (Zoology, Plate VI) was published. In addition to the slight changes in wording, the number of caudals was given as 72 rather than 77 as in the original description. I believe this to be a printer's error, since there are 75 + caudals shown in the plate. This exploration report was reprinted in "1854" without change in wording. The type has been reset and the pagination is different, placing the description on page 198. The figure (Zoology, Plate VI) in this later edition has also been redrawn or retouched and is less detailed

than the original. The original description is quoted below (Baird and Girard, 1853: 77-8).

"5. *Scotophis laetus*, B. & G. — Similar to *S. confinis*, but posterior frontals larger. Vertical plate longer than broad. Dorsal rows 29. Abdominal scutellae 227. Blotches fewer.

"This species bears a close resemblance to *S. confinis*, and its characters may be best given by comparison with the latter. It differs therefore in the greater number of dorsal rows, 29 instead of 25. The whole body and head are much stouter. Exterior eight rows smooth, rest slightly carinated. The vertical is broad before, rather acute behind. A probably monstrous feature is seen in the union of the two postfrontals, except for a short distance before, and in the loreal and postnasal coalescing into one trapezoidal plate. Blotches less numerous [than the 44 in *S. confinis*]. A broad vitta across the back part of the postfrontals, passing backwards and downwards through the eye, and terminating acutely on the posterior upper labial. A blotch across the back part of the vertical, and extending through the occipitals on each side to the nape. The spots are larger, longitudinal throughout, with occasional exceptions.

"Its affinities to *S. vulpinus* are close. The vertical, however, is narrow, the eyes much larger, dorsal rows 29 instead of 25. The blotches on the back are longitudinal, and fewer in number. For the full description of this species also, it will be necessary to procure larger specimens.

"Red River, Ark. 227. 77. 29. 18. 3¼. Cpts. Marcy & M'Clellan."

It should be noted that the type specimen of *Scotophis laetus* is a juvenile (total length, 18 inches), and it is probably due to this fact that the present confusion of names exists since juvenile specimens of *Elaphe obsoleta* have head bands (obscured in adults), as well as more lightly keeled scales, and thus approach *E. laeta* (auct.) in these characters. The head bands, however, are very characteristic in the species of *Elaphe* and two aspects of the head pattern of the type point definitely to its identity with *E. obsoleta*. The first of these is that the headbands (as well as the body blotches) of *E. laeta* (auct.) are distinctly black-bordered by the time the individuals attain a length of 18 inches, and this is neither mentioned in the description nor shown in the plate.¹ Secondly, the postorbital band terminates "acutely on the posterior upper labial" in the type of *S. laetus* (and in juvenile individuals of *E. obsoleta*), while in *E. laeta* (auct.) this band continues across the lower labials and onto the neck.¹ Both species of *Elaphe* in Oklahoma have 27 or 29 dorsals. However, other characters which are given in the original description are characteristic of *E. obsoleta* alone. This is true of the eight lateral smooth rows of dorsals which were observed in the 18-inch type specimen. In specimens of *E. laeta* (auct.) which were examined, a count of eight smooth lateral rows was obtained in only a single adult of 940 mm. (37 inches) and this count otherwise ranged from nine or ten in adults of over 900 mm. to 14 in the smallest specimen from this area (629 mm. = 24+ inches), which is, however, still larger than the type. Smaller individuals from other areas showed a minimum of 14 lateral smooth scales and in many of them all of the dorsals were smooth at midbody. This may be contrasted with the situation in *E. obsoleta* in which two specimens of 378 mm. (15 inches) and 539 mm. (21 inches) respectively had smooth lateral counts of eight; this count ranging from two (in larger specimens) to 13 (in specimens less than 18 inches long). The "longitudinal" blotches of the type which are mentioned in the description and shown in the figure are equally characteristic of *E. obsoleta*, since the

¹ It should be pointed out that this character is recognized in the descriptions of *Scotophis guttatus* (pp. 78-9) and *S. emoryi* (pp. 157-8).

blotches of *E. laeta* (auct.) in this region are always wider than long ("transverse").

Since *E. obsoleta* has more ventrals, more caudals, and fewer blotches than *E. laeta* (auct.), a maximum separation between the two species in this region may be obtained by adding the ventrals and caudals and plotting this figure against the total (body and tail) blotch number (Fig. 2). The type of *S. laetus* corresponds to *E. obsoleta* in these characters also and differs from the closest individual of *E. laeta* (auct.) by 12 scutes and 18 or more blotches. Thus it

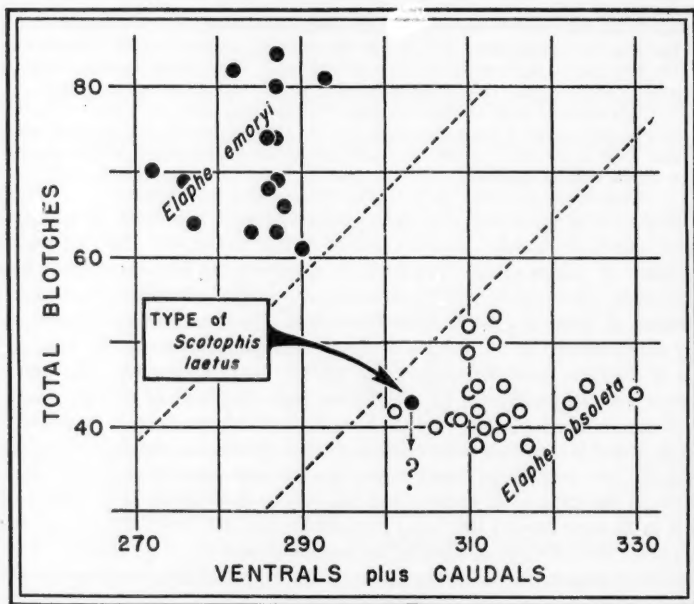


Fig. 2. Comparison of certain characters in two species of *Elaphe* and the type of *Scotophis laetus*.

appears a certainty that the name *Scotophis laetus* Baird and Girard (1853: 77-8) should be placed in the synonymy of *Elaphe obsoleta* (Say) (1823: 140).

The first available name for the form which has been masquerading under the name of *Elaphe laeta* since 1917 is *Scotophis emoryi* Baird and Girard (1853: 157-8). It is notable that this name was used in the past by many workers including Kennicott, Cope, A. E. Brown, and Strecker, and that the snake was not confused with *Scotophis laetus* until Boulenger (1894: 49-50) described a specimen of *S. emoryi* from "Mexico" under the name *Coluber laetus* (Baird and Girard). This error did not enter general usage in the United States, however, until after the first edition of the "Check List" (Stejneger

and Barbour, 1917: 82). These authors apparently followed Boulenger and listed this form as *Elaphe laeta*, placing *S. emoryi* in synonymy, possibly for reasons of page priority. As shown above, *E. laeta* belongs in the synonymy of *E. obsoleta* and cannot be used for this form. A skeleton synonymy of this snake follows.

Elaphe emoryi emoryi (Baird and Girard)²

Scotophis emoryi Baird and Girard, 1853: 157-8.

Scotophis calligaster (Harlan) [= Say, *vide* Kennicott]. Kennicott, 1859: 98-9.

[*non*] *Coluber calligaster* Harlan, 1827: 359.

Coluber rhinomegas Cope, 1860: 255.

Coluber emoryi, Cope, 1875: 39.

Natrix emoryi, Cope, 1887: 71.

Coluber guttatus Linne [*partim*]. Boulenger, 1894: 39-41.

Coluber laetus (Baird and Girard) [*partim*]. Boulenger, 1894: 49-50.

[*non*] *Scotophis laetus* Baird and Girard, 1853: 77-8.

Coluber emoryi (Baird and Girard). Cope, 1900: 852-4.—Brown, 1901: 50; 1903: 549.

Callopeltis emoryi (Baird and Girard). Strecker, 1915: 34.

Elaphe laeta (Baird and Girard). Stejneger and Barbour, 1917: 82; 1923: 91; 1933: 99; 1939: 109-10.

[*non*] *Scotophis laetus* Baird and Girard, 1853: 77-8.

Elaphe laeta laeta (Baird and Girard). Woodbury and Woodbury, 1942: 133-42.—Stejneger and Barbour, 1943: 137.

[*non*] *Scotophis laetus* Baird and Girard, 1853: 77-8.

The description of *Scotophis emoryi* was based on a specimen collected by John H. Clark at Howard Springs [ca. 20 miles southwest of Ozona, Crockett County], Texas. This type also appears to have been lost but the original description is quite specific and undoubtedly refers to the Plains Ratsnake. The type was adult, with a total length of 41¼ inches (1043 mm.) and a tail length of 7 inches (178 mm.). The ventrals were 217; caudals 72. Judging from the number of ventrals and caudals and the proportion of tail length to body length (20.6 percent) it is almost certainly a male. The other essential points of identification (from Baird and Girard, 1853: 157-8) are:

"Dorsal rows of scales 29, central five or six only carinated, and those only slightly. . . . Ground color grayish ash. A series of olivaceous brown transverse quadrate blotches along the back, 70 in number, the 50th opposite the anus. These are ten or twelve scales broad, two to three long, and separated by intervals of one to two scales. They are narrowly margined with black. . . . Head grayish ash, with a somewhat curved broad brown vitta on the back part of the postfrontals [prefrontals], which, involving the commissure of the anteorbital and superciliary, passes back through the eye, and crossing the angle of the mouth on the adjacent halves of the ultimate and penultimate labials, extends into the blotches on the sides of the neck. . . . As in the other brown marks, these stripes are margined by black."

The above features, especially the retention of head bands in the adult, are characteristic of *Elaphe emoryi*, as here understood, and cannot be related to any other species of North American snake.

I wish to express my gratitude to Dr. A. I. Ortenburger, Museum of Zoology, University of Oklahoma, for the loan of the great majority of the specimens which were used in this study, and to Dr. W. F. Blair, Department of Zoology, University of Texas, for the loan of an important series of *E. emoryi* from the Texas Panhandle.

² One other race of this species is recognized at present. It should be known as *Elaphe emoryi intermontana* Woodbury and Woodbury (1942: 140-2).

Summary.—It is demonstrated herein that *Elaphe laeta* (auct.) is not the correct name for the plains ratsnake, and that *Scotophis laetus* Baird and Girard (1853: 77–8) properly belongs in the synonymy of *Elaphe obsoleta* (Say) (1823: 140). It is further shown that the correct name for the former species is *Elaphe emoryi* (Baird and Girard).

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MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN.

The Food Habits of the Salamander *Amphiuma tridactylum*

By ALLAN H. CHANEY¹

OUR scant knowledge of the food habits of the salamander, *Amphiuma tridactylum* Cuvier, is based on laboratory observations and a few qualitative stomach examinations. Small fishes, beetles, and a salamander were found in the stomachs of specimens examined by Harlan (1827). Hargitt (1892) gave an account of amphiuma eating clams, and of one amphiuma attempting to swallow another. Captive animals were fed fresh meat and birds, but did not thrive, and finally refused to feed. They ate earthworms, but would not take insects. Davison (1895) noted that the diet included crawfish and small teleosts. Brimley (1939) reported that the food is the crawfish. Parker (1937) stated that the food consisted of crawfish and mussels, and he observed one individual eating a slimy growth on a submerged can. Baker (1937) found that captives would eat crawfish, clams, and pieces of liver. Taylor (1943) reported *A. tridactylum* eating the shed skin of *Amphiuma means*. Baker (1945) found 2 frogs, *Rana pipiens*, in the stomach of one and stated that the young of *Amia calva* are eaten. It is thus evident that amphiuma will take a variety of food.

The objective of this study was to determine the relation of food habits to size, season, and habitat in the vicinity of New Orleans.

During February, March, April, May, and October 180 amphiumas were collected from four localities in Louisiana; Audubon Park in New Orleans (Orleans Parish), Destrahan (St. Charles Parish), Mandeville (St. Tammany Parish), and Waggaman (Jefferson Parish). All except 3 were caught by hand with the aid of a heavy woolen glove which had to be squeezed out after each animal was caught to remove the water and abundant mucus secretions.

The majority of the specimens, 127, were from Audubon Park near the Tulane University campus. The area in which they were caught is a golf course bounded on three sides by paved streets and on one side by a permanent lagoon. Only 3 specimens were collected from the ditches emptying into this lagoon. The others came from shallow ditches that empty into drainage canals under the streets. After heavy rains amphiumas may be found in abundance in these ditches (Cagle, 1949).

Thirty-five amphiumas caught in Mandeville were taken from permanent ditches in which very clear artesian water flowed. The ditches averaged 2 feet in depth and had soft mud bottoms which contained sticks, leaves, and other debris. Numerous aquatic plants were present together with an abundance of small fish and crawfish, but earthworms were not seen.

Collecting from ditches within the city limits of Destrahan was much more difficult due to the muddy water. Only 6 individuals were removed from these ditches. The ditches are similar to the Mandeville ditches in size and vegetation present but differ in that they contain their maximum amount of water

¹ This study was supported in part by funds allocated by the University Council on Research for a five-year survey of the herpetofauna of Louisiana. I wish to express my appreciation to Dr. Fred R. Cagle for his assistance in the preparation of this paper.

during the rainy season and are dry for several months each year. Some water emptying into the ditches comes from kitchen drainage of houses lining the streets. Crawfish were apparently the only animals available as food for the amphiuma.

Nine amphiumas were taken from a shallow ditch near Waggaman. The water was very clear and filled with submerged aquatic plants and water hyacinths, leaving only small areas clear for collecting. Crawfish were abundant. Three other individuals caught on a trot line were in a much deeper ditch in this same area.

The amphiumas were taken to the laboratory immediately after capture, where they were drowned, measured, the stomachs removed, and both the salamanders and stomachs preserved. The stomachs were opened and cleared of all food. The volume of each food item was obtained by water displacement and the percentage of total volume of food was calculated on this basis. Most of the food was easily identified as it had been swallowed whole. The largest amount of food, two large crawfish with a volume of 30 cc., was found in the stomach of an individual measuring 53.4 cm. in body length. Forty-eight earthworms were found in the stomach of another which measured 33.4 cm. in body length.

Of the 851.19 cc. of food consumed by 180 individuals, the majority consisted of crawfish, *Cambarus blandingii* and *Cambarus ludovicianus* (52.4 percent), earthworms (24.3 percent) and vegetable matter (9.3 percent). Minor items such as insect larvae made up 5.6 percent, mole crickets, *Gryllotalpa* sp. (4.4 percent), fish, *Notemigonus crysoleucas* (2.0 percent),

TABLE I
ANALYSIS OF 851.19 CC. OF FOOD FROM 180 *Amphiuma* STOMACHS

Food item	Number of stomachs containing item	Percentage of stomachs containing item	Percentage of total food
Crawfish (<i>Cambarus blandingii</i> , <i>Cambarus ludovicianus</i>)	84	46.7	52.4
Earthworms	94	52.2	24.3
Vegetation	126	70.0	9.3
Insect larvae	56	31.1	5.6
<i>Gryllotalpa</i> sp.	37	20.6	4.4
Fish (<i>Notemigonus crysoleucas</i>)	3	1.7	2.0
Grasshopper	1	0.6	0.7
Giant water bug	1	0.6	0.5
<i>Leiopisma laterale</i>	2	1.1	0.4
Spiders	6	3.3	0.3
Snails	2	1.1	0.1

grasshopper (0.7 percent), giant water bug (0.5 percent), *Leiopisma laterale* (0.4 percent), spiders (0.3 percent), and snails (0.1 percent) of the total (Table I). The percentage of stomachs in which the three major items of food were found is the reverse of the above order. Vegetable matter was

found in 70.0 percent of the total stomachs examined, earthworms in 52.2 percent and crawfish in 46.7 percent (Table I).

The main item of food seems to vary with the locality and the type of food available (Table II). In Audubon Park the food consisted primarily of earthworms (47.9 percent), crawfish (15.7 percent), vegetable matter (15.0 percent), insect larvae (10.8 percent), mole crickets (8.5 percent), and mis-

TABLE II
THE DISTRIBUTION OF THE STOMACH CONTENTS BY PERCENT OF VOLUME OF 180
INDIVIDUALS FROM FOUR LOCALITIES

Food item	Audubon Park 127 specimens 432.49 cc.	Mandeville 35 specimens 151.50 cc.	Destrahan 6 specimens 128.6 cc.	Waggaman 12 specimens 138.6 cc.
Crawfish	15.7	93.2	99.1	79.3
Earthworms	47.9	0.1	....	....
Plants	15.0	3.9	0.6	5.7
<i>Gryllotalpa</i>	8.5	....	0.3	....
Insect larvae	10.8	0.5	....	....
Miscellaneous	2.1	2.3	....	14.0

cellaneous items such as spiders, snails, and one grasshopper together making up 2.1 percent of the total food.

The major food of amphiumas at the other localities was crawfish. The crawfish were seen in much greater abundance at the other localities than at Audubon Park. At Mandeville crawfish made up 93.2 percent of the total food, at Destrahan 99.1 percent of the total, at Waggaman 79.3 percent of the total. Two specimens of *Leiolopisma laterale* were found in two stomachs of specimens from Mandeville.

TABLE III
THE RELATION OF STOMACH CONTENTS EXPRESSED AS PERCENT OF VOLUME TO SIZE

Food item	Size Groups (in cm.)						
	0-10	10-20	20-30	30-40	40-50	50-60	60-70
	18 specimens 1.64 cc.	2 specimens 0.45 cc.	9 specimens 16.0 cc.	72 specimens 252.8 cc.	44 specimens 196.6 cc.	26 specimens 254.6 cc.	9 specimens 129.1 cc.
Crawfish	15.9	....	0.9	13.4	28.8	90.7	96.5
Earthworms	47.0	11.1	45.3	47.2	39.6	0.6	....
Plants	25.6	66.7	13.8	16.9	11.5	4.2	0.3
<i>Gryllotalpa</i>	....	....	31.3	10.4	2.9	....	....
Insect larvae	5.5	22.2	6.2	10.9	8.9	0.6	0.3
Miscellaneous	6.0	....	2.5	1.2	8.3	3.9	2.9

The relation of size to food seems to represent not primarily a size difference, but a locality difference (Table III). The small amphiumas of the 0-10 cm. size group were all caught in Audubon Park whereas the larger individuals of the 60-70 cm. group came from the other three localities. The smallest

amphiumas measured 6.0 cm. and the largest 66.2 cm. in body length. The 2 individuals in the 10-20 cm. size group also came from Audubon Park and had vegetable matter, insect larvae, and earthworms as the predominant food. In the 50-60 cm. size group which shows a predominance of crawfish in the stomachs, only 3 came from Audubon Park, the rest from the other localities.

The relation of food to season can be interpreted as availability rather than preference (Table IV). Earthworms were found in the 3 amphiumas caught during February, but all came from Audubon Park. Most of those caught in October from Audubon Park had a low percentage of crawfish. Insect larvae, mainly caterpillars, were abundant on the ground and in the ditches, and formed a high percentage at this time.

TABLE IV
THE RELATION OF STOMACH CONTENTS EXPRESSED AS PERCENT OF VOLUME TO MONTH
OF COLLECTIONS

Food item	February 3 specimens 4.1 cc.	March 69 specimens 274.27 cc.	April 75 specimens 409.43 cc.	May 21 specimens 109.24 cc.	October 12 specimens 54.15 cc.
Crawfish	....	73.4	36.8	84.7	3.1
Earthworms	56.1	4.6	42.5	0.3	33.0
Plants	24.4	6.7	11.5	5.1	14.1
<i>Gryllotalpa</i>	....	1.9	6.6	....	9.2
Insect larvae	19.5	8.1	2.1	0.7	28.6
Miscellaneous	....	5.3	0.5	9.2	12.0

Amphiumas were observed feeding both in the field and in the laboratory. Those in the field were seen feeding only on crawfish, striking with rapid movements of the head and the anterior portion of the body at motionless or moving crawfish. They often struck from their burrows and then retreated into them to swallow their prey. The amphiumas often missed the crawfish, but did not strike again, and at other times vegetation was seized and swallowed with the crawfish.

A much clearer picture of amphiumas feeding on crawfish was obtained in the laboratory. The salamanders, lying motionless on the bottom of the aquarium, became very active as soon as crawfish were introduced. Each time a crawfish was seized the amphiuma would rapidly twist its body in an apparent attempt to avoid the claws. Another amphiuma attacked a *Rana clamitans* by seizing the frog by one rear limb. The salamander twisted violently, rotating the frog. It would stop this and swim from one end of the aquarium to the other with the frog in its jaws, and at times submerging the frog with a rapid jerking motion. This procedure continued for 6 minutes, when the frog escaped. Only a small piece of one of the fat bodies of the frog was present the next morning.

Local residents have made the statement that amphiumas are attracted to crawfish by vibrations in the water made by respiratory movements of the crawfish. This seems to be disproved by the fact that 3 amphiumas were caught on a trot line baited with dead crawfish. There was no current in the water to move the crawfish and thus no vibrations.

SUMMARY

A consolidation of food analyses from 180 specimens of *Amphiuma tridactylum* collected from four different localities shows that crawfish constituted 52.4 percent, earthworms 24.3 percent, vegetation 9.3 percent, insect larvae 5.6 percent, mole crickets 4.4 percent, fish 2.0 percent, grasshoppers 0.7 percent, giant water beetles 0.5 percent, brown skinks 0.4 percent, spiders 0.3 percent, and snails 0.1 percent of the 851.19 cc. of stomach contents examined. Since a single crawfish constitutes a much larger volume than any of the other items, the percentage of stomachs in which the three major food items were found is the reverse of the above. Vegetable matter was found in 70.0 percent, earthworms in 52.2 percent, and crawfish in 46.7 percent of all stomachs examined. The primary difference in feeding habits of the amphiuma can be interpreted not as a size or seasonal difference but as a locality difference. The predominant food of each locality seems to vary with the food that was available in the greatest abundance. There was a seasonal difference in the food of amphiumas from Audubon Park. During the summer earthworms were the predominant food, but during October when there were a great many caterpillars, insect larvae were the major food item.

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TULANE UNIVERSITY, NEW ORLEANS, LOUISIANA.

Kinosternon murrayi, a New Muskturtle of the *hirtipes*
Group from Texas

By BRYAN GLASS AND NORMAN HARTWEG

AMONG the herpetological specimens taken in southwestern Texas by members of the expedition of the Fish and Game Department, Agricultural and Mechanical College of Texas in the summer of 1941 there is a single specimen of an undescribed form of *Kinosternon*. Additional specimens of this undescribed population are a poorly preserved adult male in the United States National Museum, and an adult male and a dried shell recently collected by a University of Michigan expedition in June, 1950. We take pleasure in naming this turtle after Dr. Leo T. Murray.

Kinosternon murrayi, sp. nov.

HOLOTYPE.—TCWC No. 650, young male from the Harper Ranch, 37 miles south of Marfa, Presidio County, Texas; collected August 12, 1941, by S. H. Wheeler.

PARATYPES.—USNM No. 15860, adult male from Marfa, Presidio County, Texas; collected by Vernon Bailey. UMMZ Nos. 101294, adult male, and S-1083, dried shell of adult male, paratopotypes¹; collected June 12, 1950, by Herndon G. Dowling.

DIAGNOSIS.—A *Kinosternon* of the *hirtipes* group characterized by narrow anterior and posterior plastral lobes, long interpectoral and interfemoral seams, and furcate headshield. Length of interpectoral seam as well as color pattern of head distinguish *K. murrayi* from *K. sonoriense* and *K. flavescens*, the other two members of the genus in southwestern United States. Distinguished from *K. hirtipes*, to which it is closely related, by greater interpectoral and interfemoral seam lengths, and lesser interhumeral seam length. (Figure 1.)

DESCRIPTION.—Head nearly flat above; headshield furcate; upper jaw slightly hooked. Carapace moderately elevated, more or less flattened in vertebral region, sloping gently anteriorly, rather abruptly posteriorly; keel slight but distinct on the whole vertebral series in the holotype, absent except on 4th or 4th and 5th in the three paratypes; vertebrals moderately broad, first widely in contact with second marginals; nuchal large; marginals narrow except for the 10th which is much elevated above both the 9th and the supracaudals. Plastron short and narrow, much narrower than opening of shell, sharply rounded in front in holotype and UMMZ No. 101294, indented in other two specimens (horny shields missing); posterior lobe deeply excised; gular large; interhumeral seam length variable, but rather short; interpectoral seam long, 85–140 percent of interhumeral; interfemoral seam long, 93–133 percent of interhumeral; bridge of medium length, axillary and inguinal in contact.

Web on outer edge of forearm moderately developed; postfemoral and posttibial tuberculated scales prominently developed.

¹ Harper Ranch was known as D. O. Atkinson Ranch at the time of collection of the two paratopotypes.

Scutes of carapace brown to greenish brown, with black posterior margins; plastron dark brown in areas of recent growth, light horn in older areas. Head and neck dark brown to black, with fine light reticulations above, coarser ones on sides; an ill-defined light line extends from angle of jaw to tympanic region; jaws light gray, finely streaked with dark brown or black; under sur-

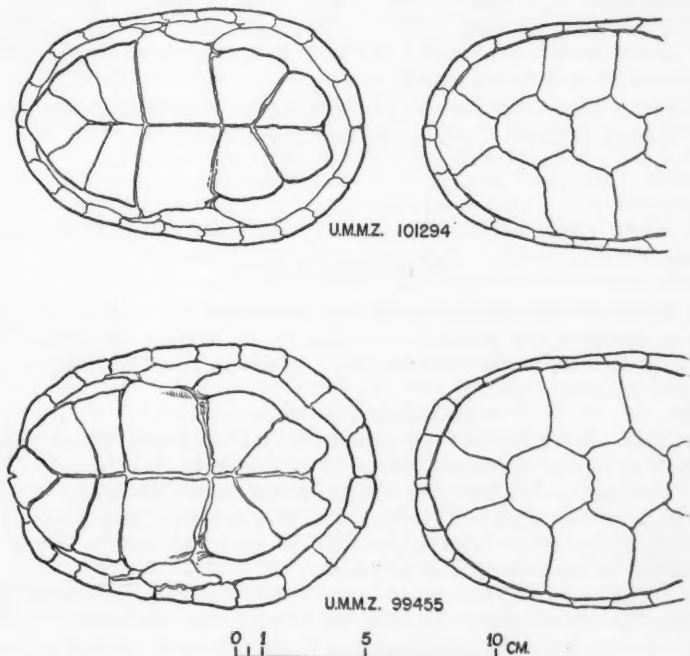


Fig. 1. Upper: Shell of *Kinosternon murrayi*, sp. nov., paratype, UMMZ No. 101294. Lower: *Kinosternon hirtipes*, UMMZ No. 99455.

face or chin and neck light gray, with scattered black specks. Limbs and tail dark gray.

Measurements pertinent to the diagnosis and description are as follows:

Catalogue number	Carapace length mm.	Plastron length mm.	Ant. lobe width mm.	Post. lobe width mm.	Bridge length mm.	Interpect. seam	Interfem. seam
						Interhum. seam percent	Interhum. seam percent
TCWC 650	107.0	90.0	45.5	43.4	17.4	85	93
UMMZ 101294	130.0	112.0	57.7	53.2	24.3	129	133
USNM 15860	145.7	117.0	58.6	52.7	24.4	140	133
UMMZ S-1083	—	118.5	57.3	56.3	22.6	94	101

Measurements, arranged in the above order, of 5 male specimens of *Kinosternon hirtipes* from the Valley of México, are as follows:

Catalogue number	Carapace length	Plastron length	Ant. lobe	Post. lobe	Bridge length	Ratio 1	Ratio 2
UMMZ 80357	116.4	96.5	50.7	47.7	17.0	45	51
UMMZ 99448	120.0	100.5	49.7	48.2	17.0	55	65
UMMZ 99449	127.4	112.0	55.7	53.7	22.5	74	66
UMMZ 99455	138.6	120.0	61.0	60.0	23.0	76	58
UMMZ 99454	141.3	118.3	59.5	54.6	22.0	50	58

A discussion of relationships within the *hirtipes* group will appear in another paper by the junior author.

DEPT. ZOOLOGY, OKLAHOMA A. AND M. COLLEGE, STILLWATER, OKLA., AND
MUSEUM ZOOLOGY, UNIV. MICH., ANN ARBOR, MICH.

A New Snake of the Genus *Tropidodipsas* from Honduras

By BENJAMIN SHREVE

I HAVE recently been identifying material collected by Dr. A. F. Carr, Jr., in Honduras and graciously presented to the Museum of Comparative Zoology by him. In this collection I find the novelty described below, which I take pleasure in naming,

Tropidodipsas carri, sp. nov.

TYPE.—MCZ No. 49797, a male, from Escuela Agricola Panamericana, near Tegucigalpa, Honduras, collected by A. F. Carr, Jr., Aug. 16, 1945.

DIAGNOSIS.—Possibly most closely related to *Tropidodipsas fischeri* Boulenger, from which it differs in number of scale rows, in having no keeled scales on the dorsum, a single postocular, a single pair of chin shields, in numbers of temporals and in coloration.

DESCRIPTION.—Eye moderate; rostral broader than deep, just visible from above; internasals about two-fifths the length of the prefrontals; frontal about one and a third times as long as broad, as long as its distance from the end of the snout, shorter than the parietals; loreal somewhat less than three times as long as deep; no preocular, one postocular; temporals 0 + 1 (parietal in contact with fifth labial); six upper labials, third and fourth entering the eye, fifth largest; six lower labials on the left, seven on the right; four lower labials on the left, and five on the right in contact with the single pair of chin shields; scales in 13 rows at midbody, smooth; ventrals 168; anal entire; subcaudals not known (tail incomplete). Snout to anus 343 mm.

COLORATION IN ALCOHOL.—Above, head dark brown, labials and temporal region whitish marked with dark brown; on each side of the dorsum a row of large spots, also dark brown, each spot usually extending about to the ventrals, alternating and coalescing with the row on the other side; between these spots a row of smaller ones near the edge of the ventrals which also may coalesce with the main row; area between spots whitish, marked with the same color as the spots and speckled with chocolate brown. Below, whitish marked with rather elongate dark brown spots each about as long as the width of a ventral scale and roughly forming themselves into two rows.

MUSEUM OF COMPARATIVE ZOOLOGY, HARVARD UNIV., CAMBRIDGE, MASS.

Observations on Gartersnakes in the Puget Sound Region¹

By WILLIAM B. HEBARD

THE COLOR PATTERN OF *Thamnophis ordinoides*

THAMNOPHIS *ordinoides* Baird and Girard displays a wide variation in color and pattern throughout its range. Fitch (1940: 100) stated that at least three differentiation centers can be distinguished within the range of *T. ordinoides*. The populations in the southernmost part of the range in northern California and southern Oregon usually have a red dorsal stripe which may be obscure; have dull, indistinct lateral stripes; a pale greenish or bluish dorsal ground color; and a pale, immaculate or red-spotted ventral surface. Populations from the interior valleys of Oregon west of the Cascade Mountains have a dark ground color, yellow dorsal stripe, distinct lateral stripes, and lack extensive pigmentation on the ventral surface. Those in northwestern Washington usually have a dark, nearly black ground color; a narrow dorsal stripe; distinct, pale lateral stripes; and heavy black pigmentation on the ventral surface.

Examination of 526 specimens from northwestern Washington indicates that this region can be further subdivided into two areas of noticeable differentiation. The central counties of King, Snohomish and Pierce have mainland populations composed principally of black, melanistic individuals with brightly colored dorsal stripes of yellow, orange, blue and occasionally red; distinct lateral stripes; heavy ventral pigmentation; and a pattern usually composed of two rows of alternate black spots between the dorsal and lateral line (Pl. I, Figs. 1 and 2). A number of broods from this area displayed this general pattern at birth. A female with yellow stripes gave birth to eight, of which four had yellow, two had orange, and two had blue-gray dorsal stripes.

The specimens from the northern counties of Whatcom, Skagit, Island and San Juan, together with those from Vancouver Island and southern British Columbia, usually are more brightly colored, with a brown, reddish or greenish ground color. The dorsal stripe, if distinct, is often red. The ventral surface is not extremely melanistic but is often covered with black specks, frequently immaculate and often heavily blotched with red. The spotted pattern is greatly reduced or diffused (Pl. I, Figs. 3 and 4). Examinations of broods from this area indicate that this reduced, spotted pattern is apparently hereditary.

T. ordinoides is composed of a large number of intrabreeding populations, each with its own endemic genetical composition and expression of color and pattern, which display varied degrees of intergradation with each other depending on the extent of interbreeding. The trend is toward melanism in the central mainland part of the range while lighter and more brilliant coloration occurs in the northern and southern populations. According to the systematic procedure suggested by Dunn (1934), these various populations should be regarded as "varieties" without special nomenclatural recognition.

¹ This study was made possible by a research fellowship granted by the Graduate Research Committee, Department of Zoology, University of Washington.

INTERGRADATION OF *Thamnophis ordinatus pickeringi* AND *T. o. tetrataenia*

Thamnophis ordinatus pickeringi (Baird and Girard) and *T. o. tetrataenia* (Yarrow) display no significant racial variation in scutellation in the Puget Sound region. Subspecific determinations are based principally on the color of the ventral surface, the color and size of the interspace blotches on the skin and width and color of the dorsal stripe (Fitch, 1941). The extreme in melanism is found in the Puget Sound subspecies *T. o. pickeringi* in which not only are the superior rows of black spots fused into a band but often the inferior rows are fused to each other and to the band above giving a solid black dorsolateral area. The ventral surface is usually heavily pigmented and the dorsal stripe narrow and irregular (Pl. II, Figs. 1 and 2). *T. o. tetrataenia*, on the other hand, exhibits conspicuous dorsolateral red markings. The ventral surface is a pale yellow and usually immaculate. The bright-yellow dorsal stripe is broad with sharply defined regular borders (Pl. II, Figs. 3 and 4).

A total of 98 specimens collected in the Puget Sound region during the summer of 1948 together with a series of 25 specimens from the Museum of Zoology, University of British Columbia were examined and the following data recorded: color of ventral surface, extent of spotted pattern, presence or absence of supralabial wedge marks, presence or absence of red coloration and the width of the dorsal stripe. Upon comparison of these data with the localities of collection (Table I), certain distributional relationships were apparent.

TABLE I
PERCENTAGE DISTRIBUTION OF *T. o. pickeringi* AND *T. o. tetrataenia* IN THE
PUGET SOUND REGION

Subspecies	King County, Washington.	Skagit County, Washington.	Southwestern British Columbia.
	Number of specimens		
	80	18	25
<i>T. o. pickeringi</i>	63%	22%	8%
Intergrades	27%	28%	60%
<i>T. o. tetrataenia</i>	10%	50%	32%

Qualitative characters, such as color and pattern, do not lend themselves readily to biometrical analysis; however, since 63 per cent of the King County specimens show definite similarity, the validity of *T. o. pickeringi* is substantiated (Dunn 1934: 169). In the north, considerable intergradation with *T. o. tetrataenia* is evident and in King County an occasional specimen will be found having all the defined characters of *T. o. tetrataenia*. As *T. o. tetrataenia* is common on the western slopes of the Cascade Mountains, there is no apparent reason why it cannot invade the lowlands of the Puget Sound region. The eastern range limits of *T. o. pickeringi* and the western limits of *T. o. tetrataenia* in Washington east of the Cascades are not known and further study of living specimens from this region should be made in order to establish adequately the ranges of these two races.

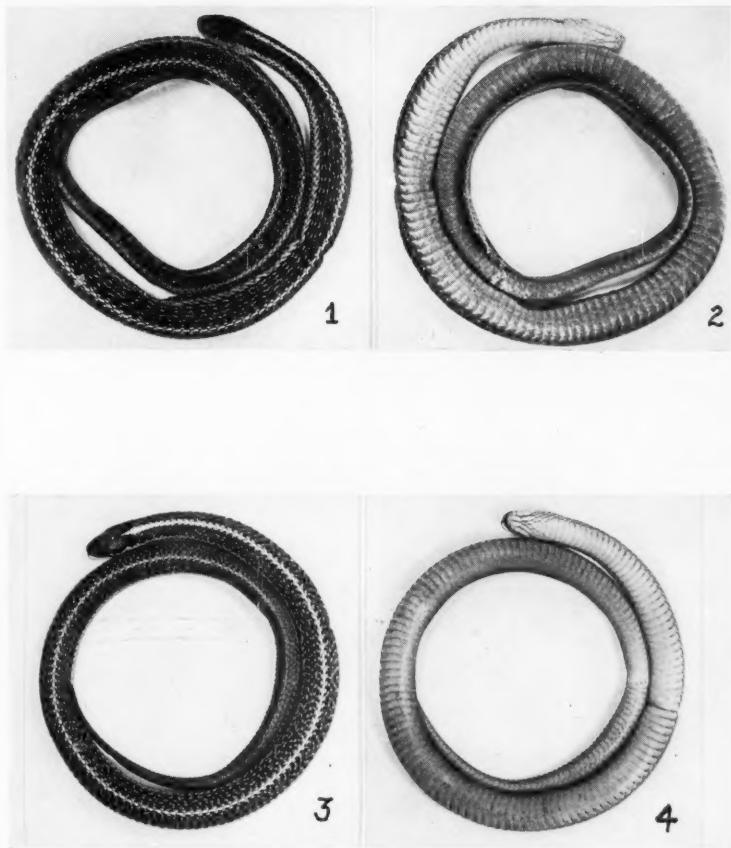


Fig. 1. *Thamnophis ordinoides*, King County, Washington. Dorsal view.

Fig. 2. *Thamnophis ordinoides*, King County, Washington. Ventral view.

Fig. 3. *Thamnophis ordinoides*, Skagit County, Washington. Dorsal view.

Fig. 4. *Thamnophis ordinoides*, Skagit County, Washington. Ventral view.

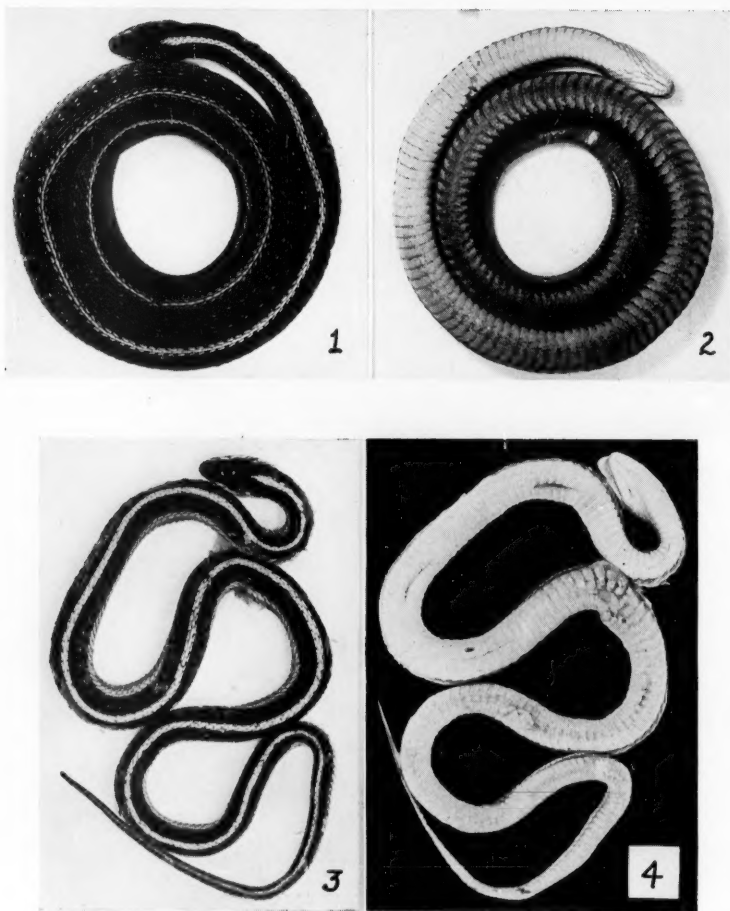


Fig. 1. *Thamnophis ordinatus pickeringi*. Dorsal view.
Fig. 2. *Thamnophis ordinatus pickeringi*. Ventral view.
Fig. 3. *Thamnophis ordinatus tetrataenia*. Dorsal view.
Fig. 4. *Thamnophis ordinatus tetrataenia*. Ventral view.

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NEW YORK CITY.

Comments on Some Recent Restrictions of Type Localities
of Certain South and Central American
Amphibians and Reptiles

By E. R. DUNN and L. C. STUART

WE HAVE elsewhere examined the validity, in the sense of sanction by the *International Rules*, of restriction of type localities by fiat of later authors and have expressed the opinion that such actions are not legally binding on later students (Dunn and Stuart, In Press).

We here take exception to some of the approximately 1600 type localities mentioned by Smith and Taylor (1950) insofar as they affect some of the countries south of Mexico. They list these for a number of countries as: 1.—“no specific locality” or “no definite locality”; 2.—without comment, and supposedly from the original description; 3.—“by restriction” or “by present restriction.” Objections can be raised against a number of the statements in each of these three categories. It is also possible to object to the placing of the type locality as far as country is concerned. Smith's and Taylor's criteria for type locality restrictions to “. . . localities from which specimens are known to have been taken, and/or to those at which there is a reasonable possibility the type or types may have been secured” are responsible for the majority of our objections.

A count of species referred to the countries Nicaragua, Costa Rica, Panamá, and Colombia shows that 27 names and 13 allocations are questionable and it can be maintained also that three names assigned to other countries should be allocated to Colombia and Panamá. Mention is made of 115 species from Honduras, El Salvador, British Honduras, and Guatemala, and restriction of 33 type localities are involved. Of these latter, 2 are perfectly acceptable, 7 are reasonable, 7 are not necessary, while 17 are untenable. In another 3 the originally designated type locality has been misinterpreted.

Smith and Taylor have dealt with the type localities of species described from the old and important collections made by Degenhardt, Warszewicz, the Colombian Government, Gabb, Hoffman, Riotte, Wright, Bransford, Morelet, Godman and Salvin, the French Mission Scientifique au Mexique, Hague, and collectors of lesser note, especially the Germans in Guatemala. Thus the implications of their allocations may affect consideration of many more species than they list.

Space does not permit consideration of all of our objections, and we have, therefore, singled out only the more prominent misstatements illustrative of

numerous types of errors and the possible confusion that could result therefrom.

Colombia (seven species mentioned).

1. No definite locality. *Bothrops schlegelli*. Objected to on the grounds that the original description gives not only "Provinz Popayan" but also a latitude and longitude which are those of the city of Popayan, 2 degrees north latitude, and 301 degrees longitude, the latter being, of course, longitude east of Ferro in the Canaries, which was the zero meridian for hundreds of years and which corresponds to the present 77 degrees west of Greenwich. This affects not only this species but all the others in the early and important collection from Colombia made by Degenhardt and sent to Berthold in Göttingen. Recent specimens from Popayan have been seen.

2. Baranquilla (*sic*). *Anolis sulcifrons*. As printed in the list this would appear to be the type locality as per the original description. It is actually a case of "by present restriction," since Barranquilla is not mentioned in that paper, which says the collection was from "near Bogotá" or made "in the neighborhood of Bogotá." The species concerned has *not* been taken in Barranquilla (nor in Bogotá either), but it, and all the others mentioned in the paper, *have* been taken "in the neighborhood of Bogotá," if that phrase is used, as it is very commonly used, to indicate a circle of 50 miles radius around a city. The species has been taken within this circle by Dunn at Mariquita. This case affects all the species in the Colombian Government Collection examined by Cope and now in the American Museum of Natural History. The collection as a whole could *not* have been made in a similar area around Barranquilla.

3. Montevideo, Uruguay. *Erythrolamprus bizona*. "By present restriction." Objected to on the grounds that there is no recent confirmation of the presence of the genus or the species in Uruguay; that, among the localities listed in the original description, Popayan, Colombia, is the only one where the form, as last described, is *known* to exist; that the only references to this as a recognizable form since the original description have been the use of the name for the common form of the genus in Costa Rica, Panamá, and Colombia; that the name was restricted "to Colombian specimens with the bands double even on the nape" by Dunn and Bailey (1939).

Panamá (four species mentioned).

1. No definite locality. *Anolis panamensis*. The word "Panamá" has had a series of meanings, all of which are still valid, but some of which have only recently become so and the more recent ones overshadow the older ones. It was first a word for a tree, then also a word for a city, in addition a word for a province, and latest a word for a country. Smith and Taylor suggest that "Panamá" as Boulenger used the word in 1890 referred to a country which did not exist until 1903. The suggestion that he meant a city is more plausible. The species has been taken more recently in Balboa, between which and Panamá City there is no great gap.

2. Chiriquí, Río (in vicinity of Bocas del Toro). *Bufo simus*. The statement is a translation of the original description, but students should be advised that material, whether in Krakau or in Berlin, collected by Warszewicz may have very erroneous original data, even though no question exists as to

his having been in the place in question. This is well known to botanists. There has been no confirmation of this species in Southern Central America or in Northern Colombia.

3. Córdoba, Veracruz, México. *Agalychnis callidryas*. As printed this would appear to be the type locality as per the original description. It is actually a case of "by present restriction," as no such locality is mentioned in the original description.

In 1945 Taylor and Smith mentioned this form with type locality Panamá. In 1948 Smith and Taylor cite this form remarking "Type: unknown" and "? Type locality: Córdoba, Veracruz," and range south only to Guatemala. In the 1950 Smith-Taylor paper the question mark of 1948 does not appear. The facts are that the original description credits the type specimen to a Captain Field—it was in "a collection made by him in Panamá"—and it is now in the collection of the Philadelphia Academy with the number 2091. Specimens agreeing with the type have recently been taken on Barro Colorado Island in the Panamá Canal Zone. No Mexican examples have been compared with the type, and as Kellogg (1932) referred Mexican specimens to the closely related *A. helenae* (taken originally by Lt. J. G. Moser, probably along the San Juan River in Nicaragua) and compared Mexican specimens with the original material of *A. helenae*, the very existence of this form in México is arguable.

Costa Rica (nine species mentioned).

1. Arriba. *Bufo coccifer*. This is probably not a definite locality. It is given as the locality for specimens collected by C. N. Riotte, but since it has been found on no map, nor is it listed as a Costa Rican locality by Carriker (1910), Noriega (1923), or Valerio (1936) nor locatable by Dunn in four extensive trips, its existence as a place is very dubious, and the word "arriba" may have been used merely to indicate the "up-country," the "Meseta Central," where the species is very common.

2. Arriba. *Anolis nannodes*. "By present restriction." (See above for "Arriba.") Dunn (1930) mentioned that Costa Rican type material of *A. nannodes* was conspecific with Costa Rican type material of the older name *A. intermedius*, without prejudice to the Guatemalan and Mexican type material of *A. nannodes* (to which he paid no attention) and the name was thus left free for future workers. Stuart (1948) further restricted the type material (and the use of the name) to that from Cobán, Guatemala. It is obvious that this method is economical of named entities, whereas manipulation of the name *A. nannodes* into the synonymy of *A. intermedius* may well lead to that unnecessary multiplication of entities which is so contrary to the first principles of scientific work. The present restriction is thus objected to as violating both priority and first principles. It is merely a minor matter that the locality seems to be a figment of the imagination.

3. Palmar. *Anolis capito*. "By present restriction." Objected to on the grounds (1) that it tends to force the identity of *A. capito* and *A. longipes* (type locality Palmar) and thus prejudice by fiat an issue which should be decided only by further study of the descriptions, the type specimens, and additional material, and to force a type specimen into an area which *may* be inhabited by a different population; (2) the type of *A. capito* was sent to

Peters in Berlin by Dr. C. Hoffmann who collected in Costa Rica in the late 50's and early 60's of the last century and who died in the country. He is definitely known to have been on Volcán Barba, and therefore was presumably in San José, and in and around the Meseta Central, and could have taken *A. capito* at the adjacent recent localities of Azahar de Cartago or Irazú. While it may now be easy to go to Palmar from San José, it was not so in Hoffmann's time. As late as 1925 Tschiffely found it the most difficult passage in his ride from Buenos Aires to Washington. It is virtually certain that Hoffmann was *not* in Palmar, and this fiat restriction of the type locality is unacceptable.

Nicaragua (seven species mentioned).

1. No definite locality. *Hyla ebraccata*. The type specimen of this, ANS No. 2079, is labeled "Machuca," and so are the types of *Anolis bransfordi* and of *Dendrobates ignitus*, also in the Philadelphia Academy. Students of Nicaraguan herpetology would do well to note that Dr. Bransford was associated with Lull and Menocal in their Canal Surveys, and was with them in Nicaragua in 1873 (collection of *Hyla ebraccata* and 27 other species); in Panamá in 1875 (Cope's title "Nicaraguan Canal Survey" for this collection is misleading as *all* localities and specimens are Panamanian); in Nicaragua in 1885 (31 species), the work of that year being entirely along the San Juan River. The word "Nicaragua" in reference to material collected by Bransford is not a definite locality, but it does mean "definitely" that part of Nicaragua along the San Juan River.

2. No definite locality. *Cnemidophorus decemlineatus*. This and other Nicaraguan specimens (20 species) are attributed to the "Rodgers Expedition," which is quite incorrect, as the Rodgers expedition was never within 1000 miles of Nicaragua. Charles Wright was on the Rodgers Expedition to the North Pacific, left it in San Francisco, and proceeded thence to Nicaragua (he was definitely at Omotepe). The year was 1856, William Walker was there, and by the "internal troubles of the country" (according to the official Smithsonian records) Wright "was prevented from completing his explorations. He has since gone to Cuba" (actually to eastern Cuba). The species concerned is known only from the Pacific side of Nicaragua, and Granada is the nearest modern locality for this species to Omotepe.

3. Recero. *Leptodactylus melanonotus*. "By present restriction." That Charles Wright, making the best way out of the country on his way to Cuba, paused to take a side trip 90 miles up the Escondido river to visit Recero is highly improbable. The species is known to occur at San Carlos, which Wright must have passed, and where he may have paused.

Honduras (eight species mentioned).

1. Portrillo Grande (Yoro). *Adelphicos quadrivirgatus visoninus*. "By present restriction." Schmidt (1941: 503) has suggested that all Dyson material labelled as of Honduras actually originated from British Honduras. This probability affects *Pseustes p. poecilonotus* and *Emys venusta* as well as the above.

El Salvador (eight species mentioned).

1. La Union. *Stenorrhina freminvillii lactea*. "By present restriction." Typical of an unnecessary restriction. Cope, almost consistently, cited Capt. Dow's material as of "La Union, Guatemala." The collections were made

during the regime of Carrera and it is possible that El Salvador may have been included with Guatemala for brief periods between the numerous battles that were common-place throughout Central America during the great dictator's term of office.

2. La Union. *Plastoserix bronni*. "By present restriction." Described from "America Meridional," Taylor and Smith (1945: 27) place this name in the synonymy of *Loxocemus bicolor* with a question mark. If it is a synonym, the type could have originated from any part of the Pacific Coast from Guerrero, México to Costa Rica.

British Honduras (fourteen species mentioned).

1. Belize. *Dermatemys abnormis*, *Thamnophis sumichrasti praeocularis*, and *Tretanorhinus nigroluteus lateralis*. All "by present restriction." Apparently an effort on the part of Smith and Taylor to avoid confusion between the colony (often known as Belize or Belice) and its capital (Belize). *Dermatemys abnormis* was originally recorded from the Belize River. It seems hardly probable that the form would inhabit the salt and brackish water of the river's distributaries in the vicinity of the town. The other two need no further restriction since the town of Belize was the only locality visited by the Mission Scientifique within the boundaries of Belize colony of that day. *Tretanorhinus nigroluteus lateralis* was, moreover, originally listed as of "the slime of the Belize swamp during the dry season."

Guatemala (seventy-eight species mentioned).

1. Alta Verapaz. No definite locality. *Claudius pictus*. "By present restriction." Described by Cope from Duméril and Bocourt's figure of *Staurotypus salvini* (1870: Pl. 5, Figs. 3) which originated from "a tributary of the Rio Polochic." Cope merely failed to cite the original source of the specimen in full, listing only "Verapaz."

2. Cobán. *Cinosternum cobanum*. "By present restriction." Described from specimens allegedly from both Cobán and Cahabón, Smith and Taylor chose the former locality where no turtle is known to occur, over the more probable locality Cahabón. *Micrurus affinis apiatus* as of Cobán also "by present restriction" is a parallel case. Recent intensive collecting by K. P. Schmidt and Stuart has failed to reveal the form on the pine-covered Meseta of Cobán. Stuart (1948) has reviewed the many errors that have been produced in the herpetological literature owing to the fact that Cobán served as an important shipping center. Ornithologists have long been aware of the skepticism with which this important "trade-skin" locality must be treated.

3. Cobán. *Anolis petersii bivittatus*. "By present restriction." A case paralleling that of *Anolis capito* noted above. The type was collected by Sapper who could have secured the specimen almost anywhere in Guatemala as it was labeled. The species is known from both coasts, but only reexamination of the types can settle the question as to whether or not the type species and *Anolis p. bivittatus* are identical.

4. Cubilguitz. *Leptognathus semicinctus*. "By present restriction." The type was collected by the Mission Scientifique which was never closer than Cobán to Cubilguitz. A lowland species, it probably came from the vicinity of Panzós, the only lowland locality in Alta Verapaz visited by the Frenchmen.

5. Baja Verapaz. No definite locality. *Anolis carneus*. No comment. A misinterpretation of the Godman-Salvin locality "Verapaz, low forest" which

was cited by Cope in his description as "lower Verapaz forest." The type probably came from the vicinity of Cubilguitz in Alta Verapaz (see Stuart, 1948: 8).

6. El Petén. La Libertad. *Geoemyda areolata*, *Gymnodactylus coleonyx*, *Gymnodactylus scapularis*, *Thalerophis occidentalis praestans*, all "by present restriction." The types of the first three were secured by Morelet. In an account of his journey (1857) Morelet notes that he actually spent a night at La Libertad (Sacluc) before continuing on to Flores. At Flores he spent something like six weeks recuperating from various illnesses and then proceeded to Cobán, stopping briefly at San Luis and Dolores in the Petén. Inasmuch as a single night only was spent at Sacluc, it seems improbable that he would have collected specimens at that point. He was in fact more concerned with the illness of a companion who had drunk immoderately of swamp water. At Flores, however, he purchased many specimens from the natives of the village, and he mentions collecting, especially molluscs, at San Luis. It would seem that the greater portion of his Petén collection originated from the vicinity of Flores, though reptiles from both San Luis and Dolores are referred to in his account. He definitely states that the type of *Gymnodactylus scapularis* was secured from the church wall in San Luis. Aside from that species it seems probable that other undescribed material collected by Morelet in the Petén originated from Flores. Certainly *Lepidophyma f. flavomaculatum* more probably came from there than from an indefinite locality on the Río de la Pasión (well to the west of Morelet's route) to which its type locality has been restricted. In the case of *Thalerophis o. praestans*, collected by Hague and said to have come from "near Petén," Hague certainly knew Guatemala well enough to know whether or not he was in that province. The type probably originated from the lowlands of Alta Verapaz. Another Hague type, that of *Bascanion suboculare* was secured from "between Cobán and Chisec" and it is not improbable that the type of *Thalerophis o. praestans* came from the same general area.

7. Santa Teresa, 2 miles north of. *Anolis humilis uniformis*. "By present restriction." This form was described from material collected by Schott in Yucatán and by Hague in Guatemala. The material from Guatemala certainly never came from Santa Teresa which did not exist prior to 1930 and will probably have been reclaimed by the forest by 1960. Smith and Taylor did not designate lectotypes, a procedure which perforce would have to precede type locality restriction. There is good probability that the Hague types originated from the same general area as that of *Thalerophis o. praestans*, both of which have since been collected on the lowlands of northern Alta Verapaz.

8. Sololá. Atitlán. *Virginia fasciata* (= *Tropidodipsas fischeri*). "By present restriction." No such locality has ever existed. Atitlán is a general area around the lake of the same name and the term is utilized only as a descriptive term with village names, e.g., San Lucas Atitlán, through which the Mission Scientifique passed. Why the type locality of *Virginia fasciata* should have been restricted to Volcán Atitlán and its substitute name *Tropidodipsas fischeri* to Atitlán is not clear. The type of *V. fasciata* was collected by Sarg, an early German consul. The Smith-Taylor restriction is apparently based on the Mission Scientifique record from "Godines, northeast of Volcán Atitlán" which

is ecologically a far cry from the volcano. The species has recently been secured in the vicinity of the commercial center Tecpam, which Sarg undoubtedly visited many times.

9. Mazatenango. Hacienda de Chitalón. *Tropidodipsas sartorii annulatus*. "By present restriction." Originally described as of "probably South America," we are not even certain that our current application of the name is correct. Chitalón is, incidentally, an old and famous hacienda from which originated much of Bernoulli's material, now in the Basel Museum.

10. Sacatepequez. Antigua, Volcán. *Sceloporus squamosus*. "By present restriction." Originally described from material originating from Guatemala [? City], the Río Nagualate, and Antigua. With three perfectly satisfactory localities from which to choose, there seems to be no justification for selecting a fourth, and especially one which suggests high elevations. The species is common in the rock walls of the Antigua Basin up to about 1600 meters.

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DEPARTMENT OF BIOLOGY, HAVERFORD COLLEGE, HAVERFORD, PENNSYLVANIA,
AND INSTITUTE OF HUMAN BIOLOGY, UNIVERSITY OF MICHIGAN, ANN
ARBOR, MICHIGAN.

The Tadpole of *Leptodactylus melanonotus* (Hallowell)

By GRACE L. ORTON

LEPTODACTYLUS is one of the major genera of neotropical frogs, but the tadpoles of few of its species have been described and little is known concerning their diagnostic characters and variation. There is need for such studies, not only as an addition to the knowledge of tadpole stages in general, but also because of the potential usefulness of larval characters in helping to clarify systematic problems in this complicated genus.

Recent acquisition by Carnegie Museum of three series of tadpoles of *Leptodactylus melanonotus*, collected by Dr. Arthur C. Twomey and R. W. Hawkins on the Bay Islands, Honduras, provides an opportunity for study of larval characters of this species. Heretofore, the tadpole of *L. melanonotus* has been known only from brief notes by Gaige (1936) on a single specimen from Yucatan. This specimen (UMMZ No. 73200) is, unfortunately, somewhat abnormal in buccal characters. The lower lip is notched medially and all three of its tooth rows are divided, apparently the result of an injury or accident of development.

L. melanonotus has a rather confused taxonomic status. Smith and Taylor (1948) listed its range as "southern Sonora and San Luis Potosí southward along both coasts to Costa Rica." The type locality is Nicaragua. Bogert and Oliver (1945) suggested the possibility that several subspecies may be definable when sufficient material has been assembled. In view of the unsettled status of these frogs, the larval description in the present paper is based entirely on the Honduras material; larvae from other parts of the range are used to provide data on variation. The possibility of insular differentiation should not be overlooked, but the Bay Islands are sufficiently near the Nicaraguan border so that their populations are probably typical or nearly so.

ACKNOWLEDGMENTS.—I am indebted to Dr. Arthur C. Twomey of Carnegie Museum (CM) for obtaining the tadpoles described in this paper. For the opportunity to examine larvae of *Leptodactylus* in other Museum collections I wish to thank Mr. Charles M. Bogert of American Museum of Natural History (AMNH), Dr. Doris M. Cochran of United States National Museum (USNM), Dr. Norman Hartweg of the University of Michigan Museum of Zoology (UMMZ), and Mr. Clifford H. Pope of Chicago Natural History Museum (CNHM).

SPECIMENS EXAMINED.—The specimens referred to in this paper are as follows: *Leptodactylus melanonotus*: CM Nos. 27606 (298) and 27607 (13), Ruatan Island, Bay Islands, Honduras, collected April 8, 1947; CM No. 28996 (27), same locality, collected April 14, 1948; AMNH No. 53951 (25), between Nautla and Tecolutla, Veracruz, México, collected March 30, 1948; AMNH No. 53983 (23), ½ km. southwest of Minatitlan, Veracruz, México, collected March 4–11, 1948; CNHM No. 32000 (31) branch of Papagayo River, 20 mi. southwest of Chilpancingo, Guerrero, México; UMMZ No. 73200, north of Piste, Yucatan, México. *Leptodactylus albilabris*: CM No. 23783 (63), Kingshill, St. Croix Island. *Leptodactylus ocellatus*: CNHM No. 6470 (2), Humboldt, Santa Catharina, Brazil; USNM Nos. 84665–66 (58),

Rio de Janeiro, Brazil; UMMZ No. 58517 (2), Rio Humboldt, Santa Catharina, Brazil.

The two series of *L. ocellatus* in the United States National Museum were collected by Maynard Metcalf, and are evidently part of the material used in his studies on opalinid parasites. Most of these specimens have part or all of the viscera removed.

DIAGNOSIS.—A very generalized leptodactylid tadpole. Body somewhat flattened, tail muscle well developed, fins low, tail tip pointed. Eyes small, dorsal in position. Spiracle sinistral, anus median. Tooth row formula 2/3; lips not infolded laterally. All body and tail surfaces with dense, uniform, dark pigmentation. Maximum known total length, 38 mm.

DESCRIPTION.—(Fig. 2). Body moderately narrow, somewhat depressed; ventral profile only slightly convex, no abdominal bulge; snout short and blunt, moderately thick. Eyes small, dorsal, moderately close together. Nostrils small but distinct, with simple rims; nostril about equidistant between eye and lateral base of lip; internasal distance distinctly less than interorbital. Spiracle sinistral, inconspicuous, nearer to ventral base of tail than to tip of snout, its margin tubular but not projecting. Anus median, its tube extending slightly below margin of ventral fin. Tail muscle moderately thick; fins rather low, the dorsal originating on base of tail; tail tip pointed.

Mouthparts (Fig. 3) of generalized leptodactylid type. Lips of moderate size, not infolded laterally. Rows of labial teeth 2/3, the teeth numerous and very closely crowded; second upper tooth row very narrowly divided, first lower row continuous (rarely narrowly divided), the other rows continuous; third lower row slightly shorter than second lower row, and its teeth of slightly smaller size. Beaks narrowly edged with black, minutely serrated. Marginal papillae of lips small and very numerous, in irregularly crowded double row ventrally and approximately a triple row laterally; all papillae of about the same size.

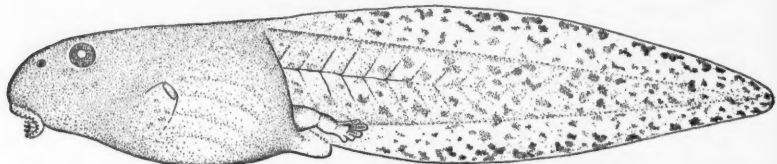
All surfaces of body and tail with very heavy, uniform, dark pigmentation (probably black in life); melanophores most widely spaced on belly and most densely crowded on tail fins; no actual pattern other than scattered small light areas on tail fins. No evident pigmentation marking course of lateral segmental blood vessels on tail muscle.

Largest larva measures 38 mm. in total length, 14.5 mm. in head and body length; hind leg buds 4.5 mm.

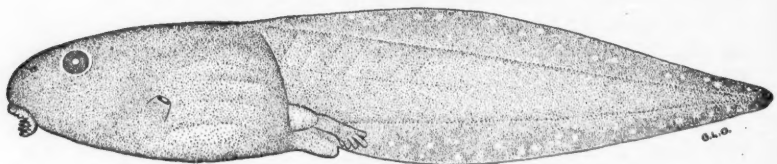
YOUNG LARVAE.—The Honduranian larvae examined fall into two size groups differing widely in measurements and in developmental condition. The description above is based on the 35 large specimens. The 303 small tadpoles have the following characters: total length approximately 8–11.5 mm., head and body length about 4–5 mm.; hind leg buds visible in a few specimens as minute, thickened, white spots; body rather narrow, somewhat depressed; eyes very small; tooth rows 2/3; second upper tooth row narrowly divided, first lower row continuous in all but one specimen; body and tail heavily pigmented, essentially as in the older larvae except tail fins less densely pigmented; edges of fins and of anal tube tend to be free of dark pigment; melanophores on tail fins much larger than those on tail muscle.

VARIATION.—The two series of *L. melanonotus* from Veracruz and one series

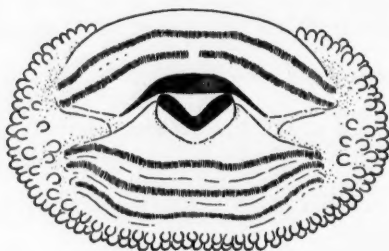
from Guerrero, listed above, closely resemble the described material from Honduras in general proportions, basic characters of the mouthparts, and uniformly heavy pigmentation. The Veracruz specimens measure ± 13 –32 mm. in total length; all have the second upper tooth row narrowly divided and the first lower row continuous. In the series from Guerrero, the maximum total



1



2



3

Fig. 1. *Leptodactylus albilabris*. Lateral view; total length 37 mm., head and body length 14 mm. CM No. 23783, St. Croix.

Fig. 2. *Leptodactylus melanonotus*. Lateral view; total length 36 mm., head and body length 13.5 mm. CM No. 27607, Honduras.

Fig. 3. *Leptodactylus melanonotus*. Mouthparts. CM No. 27607.

length is 27 mm. In leg bud development, these specimens are comparable to the 24.5–28 mm. size group in the Honduras material, hence it is probable that the actual maximum size is similar in the two areas. In the Guerrero larvae the second upper tooth row is divided in 9, but is continuous in 22; the first lower tooth row is continuous in 23, divided in 8. In the Honduranian

tadpoles, the spiracle is closer to the ventral base of the tail than to the tip of the snout; in Veracruz larvae (only AMNH No. 53951 was examined for this character) the spiracle appears to be slightly closer to the tip of the snout, and in the Guerrero tadpoles it is definitely so. Spiracle position (longitudinally) is difficult to determine in specimens that are much shrivelled or crushed. Whether the differences in spiracle position and tooth row continuity indicate consistent population differences in these widely separated regions will require study of larger series. Variation in tadpole characters is still very poorly understood, and the differences suggested by these small population samples are perhaps of only local significance.

COMPARISONS.—Superficially, the very heavily pigmented tadpoles of *Leptodactylus melanonotus* somewhat resemble larvae of *Bufo*, which are usually very dark, but the morphological characters (especially the mouthparts) easily separate *L. melanonotus* from toad tadpoles.

Larvae of other Middle American forms of *Leptodactylus* are still very incompletely known, but the Carnegie Museum collection contains a large series of *L. albilabris* from St. Croix Island, collected by Harry A. Beatty, which provides useful comparative data (Fig. 1). This series, CM No. 23763, consists of 40 tadpoles ranging from 22 to 38.5 mm. in total length (9–15 mm. in head and body length), and 23 specimens in various stages of metamorphosis. The latter measure 13–15.5 mm. in snout-vent length. *L. melanonotus* and *L. albilabris* are closely similar in size and proportions, and in buccal characters. Both are very generalized leptodactylid tadpoles with few conspicuous diagnostic characters. The former differs from *L. albilabris* chiefly in having much heavier, uniform pigmentation, slightly smaller head and narrower lips, first lower tooth row more frequently continuous, and a tendency for the second upper tooth row to be continuous (in Guerrero larvae). In the series of *L. albilabris* at hand, the dorsal surfaces and sides of the body are plain brownish, the ventral surfaces have very little dermal pigment except for a variable amount of dark mottling on the throat; tail muscle pale with variably heavy dark mottling, tail fins similarly mottled; lateral segmental blood vessels on tail muscle pigmented, regularly outlining the basal somites. Of the 40 tadpoles in the series, the second upper tooth row is divided in all, the first lower row continuous in 16, divided in 24.

The series of *L. albilabris* from St. Croix differs in several respects from the description of Puerto Rican tadpoles of this species given by Stejneger (1904). According to him, this tadpole has the sides of the lips "forming an inward fold" (1904: 578, and Fig. 14 on page 577). The lateral infolding of the lips that occurs in *Rana*, *Bufo*, and certain other genera, does not exist in any tadpoles of *Leptodactylus* that I have examined, or in described larvae of other species in this genus. The true lateral infolding is a permanent structural character of the tadpole, not a transitory condition dependent upon whether the lips happen to be open or closed. Stejneger's figures and his description of the mouthparts were based on a single specimen in which the lip structure may have been atypical, distorted, or otherwise subject to misinterpretation.

The measurements given by Stejneger indicate a somewhat greater total length and a relatively longer tail than in the St. Croix series in the Carnegie Museum collection. He listed the body length as 15 mm., the tail length 31 mm.; this would give a total length of 46 mm., unless his method of taking

the respective measurements resulted in some overlap. The largest specimen in the St. Croix series has a head and body length of 15 mm., total length 38 mm.

The tadpole of the mainland *Leptodactylus labialis* is still rather incompletely known. Mulaik's (1937) data on Texas specimens indicate that this tadpole attains a total length of about 38-40 mm., and that it differs from Stejneger's description of *L. albilabris* in several body proportions, more widely divided second upper tooth row, and slightly shorter third lower tooth row. Pigmentation of the fully developed tadpole was not described. It may be appropriate to emphasize that the specific status of *L. albilabris* and *L. labialis* is in need of thorough study.

The tadpole of *Leptodactylus melanonotus* resembles that of *L. ocellatus* in some features, especially the dense and uniform dark pigmentation, general characters of the mouthparts, and tendency for the second upper tooth row to be continuous instead of divided. *L. ocellatus* differs in its larger size (attains a total length of at least 52 mm.), body narrower and thinner, labial papillae more numerous, especially laterally (in three or four very crowded rows), and second upper tooth row typically continuous instead of only occasionally so.

Except in the Discoglossidae, most generalized tadpoles with a tooth row count of 2/3 have the second upper tooth row divided medially. The few known exceptions include *Leptodactylus ocellatus* (Fernandez and Fernandez, 1921), *Calyptocephalus gayi* (Werner, 1897), Javanese specimens of *Rana kuhli* (Dunn, 1928), and at least some tadpoles of *Gastrotheca* (specimens in UMMZ). Discovery that the second upper row tends to be continuous in Guerrero populations of *Leptodactylus melanonotus* adds another species to the small list of forms known to have this unusual character.

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SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CALIFORNIA.

The Specific Characters of the Celesti, with the Description of a New Species of *Celestus* (Sauria, Anguidae)

By CHAPMAN GRANT

WHILE collecting and preserving several hundred specimens of seven species and subspecies of West Indian celesti, and handling and observing as many more during several years of field work, certain characters which are frequently listed as specific appeared to me to be of generic value.

The specific characters which may be relied upon are: (1) arm length compared to distance from snout to ear; (2) number of undivided lamellae under longest toe; (3) scale count, mental to vent; (4) scale count around midbody; (5) number of pairs of chin shields; (6) character of keels and striae on dorsals; (7) position of angular subocular between upper labials; (8) average adult size; and (9) color pattern. Frequently one only of the above characters will suffice to classify a specimen.

There are two groups of celesti, one having arms longer than the snout-to-ear distance, and the other, equal or shorter. This proportion is evident at any age (size) and immediately separates the long-armed *C. duquesneyi*, *C. occiduus* and *C. o. hewardi* from the short-armed *C. maculatus*, *C. plei*, *C. cruscus*, *C. c. molesworthi* and *C. c. cundalli*.

The number of undivided subdigital lamellae under the longest toe is correlated with arm length, and is mentioned here for the sake of those who, in the past, have confused the short-arm-and-fewer-lamellae group with the young of the long-arm-and-more-lamellae group. Members of the long-arm group live in stone walls, cliffs, heaps of coconut husks or similar dry habitats and make their escape by running. Members of the short-arm group live beneath objects or among dead leaves and escape by wriggling. Their habitats do not necessarily overlap. All stages of growth of each group were found, but no intermediates between the two. The number of lamellae does not change with growth.

The number of scales between the mental and the vent is a more accurate count than "ventrals from the anal plates to the center of the breast level with the axillae" (Cochran: 246). The necessary additional counting excludes differences of opinion as to where to stop. There is no change in scale numbers with growth. This count immediately distinguishes *C. barbouri*, with 140 scales, from the remainder of the short-arm group. The nearest approach is made by *C. c. molesworthi* which averages 117. A dorsal count is unnecessary as it is proportionate to the ventral one, and there is no definite place to end the count caudad.

The scale count around midbody seldom varies by more than six in any species and has valuable diagnostic significance.

The number of chin shields does not change with growth. This count immediately identifies *C. duquesneyi*, which has six or seven chin shields; other species have four or five.

Keels are present on the dorsal scales of the members of the long-arm group and of some representatives of the short-arm group. Samples should be

taken standardly at midbody near the median rows. There is some variation in keeling within a species. The number of striae is also of diagnostic value.

In the short-arm forms, with their relatively shorter snouts and smaller heads, the angular subocular is wedged between labials nearer the snout. In the *crusculus* group it is between labials 5 and 6 or 6 and 7. In the long-arm group and *C. barbouri* it is between 7 and 8, and in the giant *C. o. occiduus* between 8 and 9.

Average adult size is diagnostic. Thus, *C. o. hewardi* averages 113 mm. snout to vent; the short-arm group ranges from 60 mm. in *C. c. crusculus* to 74 mm. in *C. c. molesworthi*. In the long-arm group, the males are larger and have heavier heads than the females; in the short-arm group the females are longer bodied than the males.

Color pattern separates almost all species at a glance. However, a specimen preserved in formalin may have its pattern obliterated. Breeding members of the *crusculus* group and some others have salmon and orange colors which disappear in preservative, but the true pattern is not disfigured. Some juveniles lack the complete adult pattern, but can be identified by their incipient pattern.

In view of the preceding, I do not believe that *C. crusculus*, with the short arm, the small lamellae count, the anteriorly wedged subocular, the smaller number of chin shields, the smaller size, the different color pattern as well as different habits, habitat and no evidence of intergradation with *C. o. hewardi*, is the young of "*occiduus*" (Cochran: 249).

Cochran (*loc. cit.*) recognized two species of *Celestus* as occurring on Jamaica: *C. impressus* and *C. occiduus*. I believe *C. impressus* is a synonym of *C. occiduus*, and both E. R. Dunn and the late Leonhard Stejneger agreed with me (*in litt.*). Cochran makes no mention of *C. barbouri* or *C. duquesneyi*, two Jamaican forms described by me (1940: 101-106 and 1940a: 151-157). Since my descriptions appeared in 1940, it may have been too late to include mention of them in her work which appeared in 1941.

The species hereinafter described as new bears the same relation to the rest of the recognized forms on Hispaniola as the *crusculus* group bears to the *occiduus* group on Jamaica. The entire type series was collected by Mr. Anthony Curtiss, in whose honor the species is named.

***Celestus curtissi*, sp. nov.**

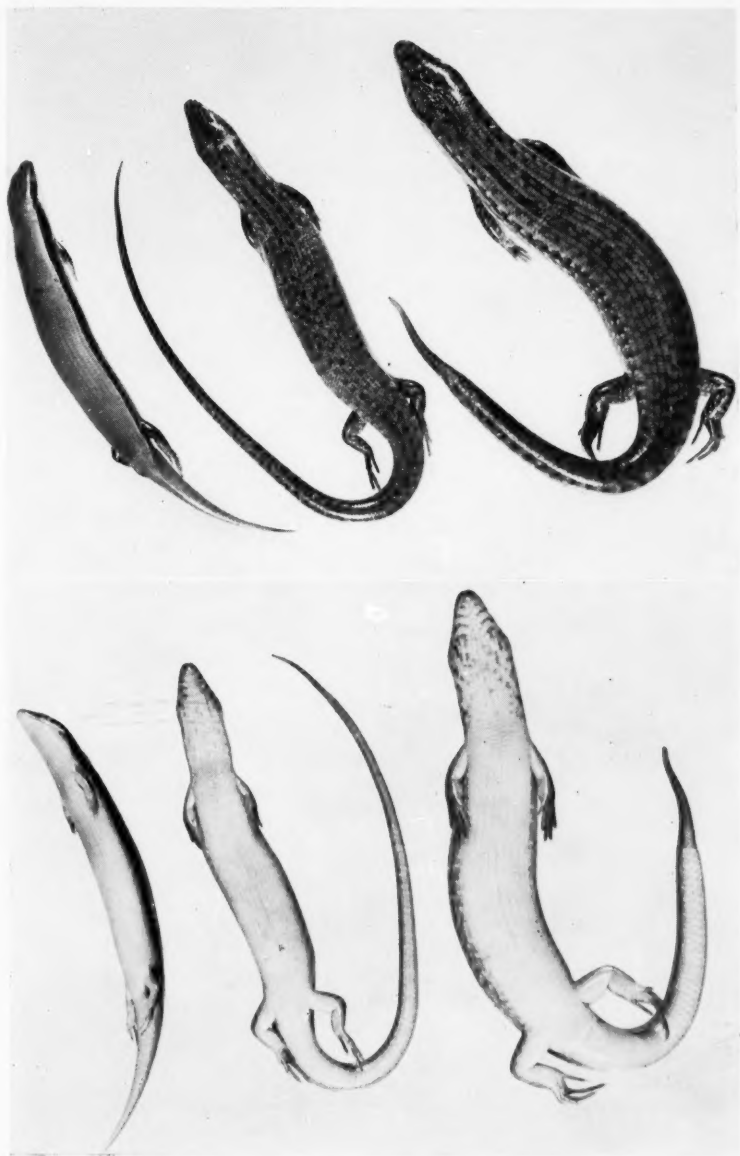
PLATE I

TYPE.—USNM No. 117337, adult male from Trou Forban, Haiti; collected by Anthony Curtiss.

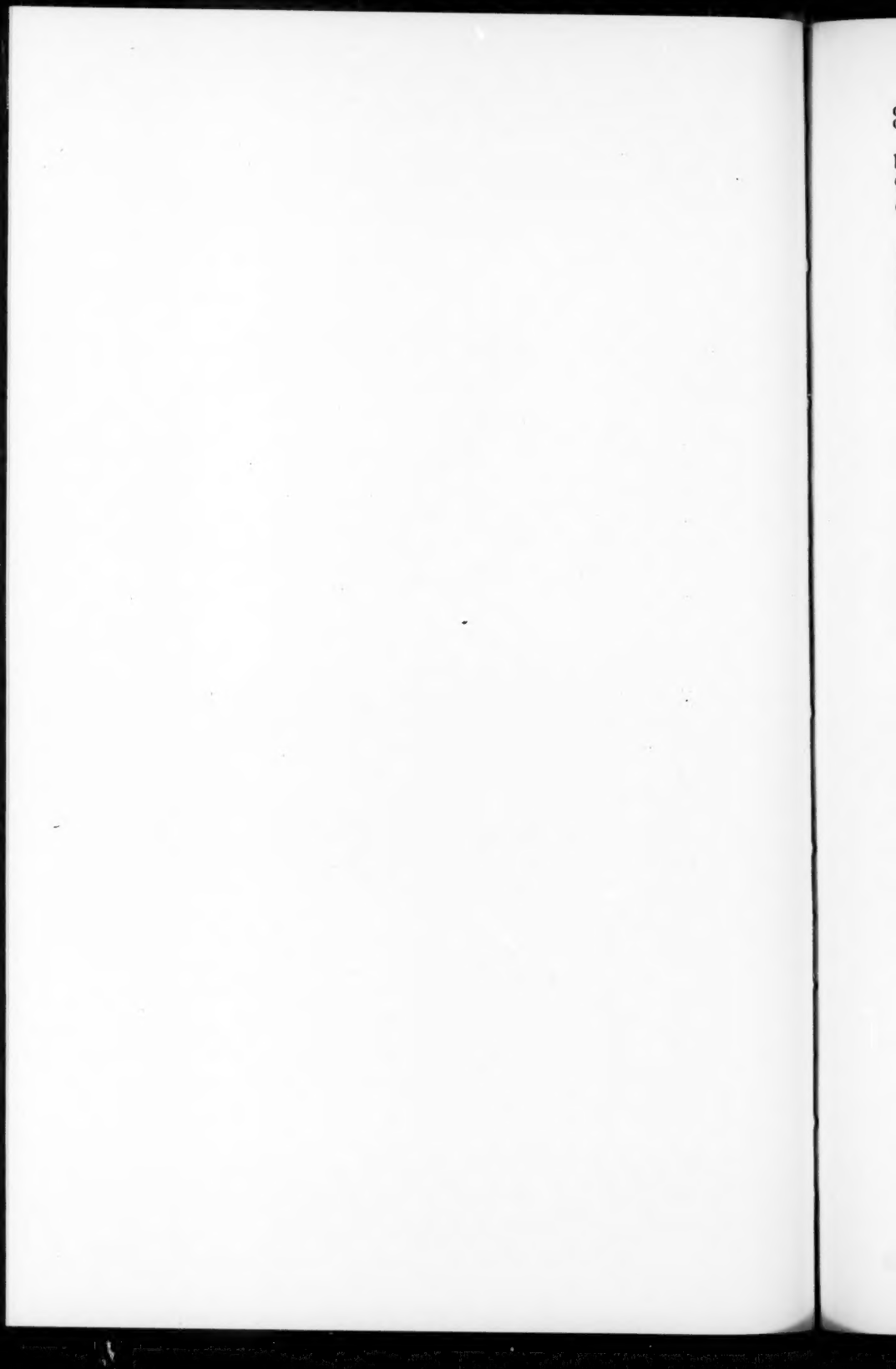
PARATYPES.—USNM Nos. 117265-68, 117338; C. Grant Haitian Collection No. 75. All from Trou Forban except No. 75 which is from L'eau Gaillé.

DIAGNOSIS.—A *Celestus* of the short-arm group, closely related to the *crusculus* group of Jamaica. Differs from other Hispaniolan celesti in having fewer scales rows (35 against 40); fewer subdigital lamellae (15 against 18); fewer upper labials (8 against 9 or 10); weaker legs; smaller head, patternless dorsum; continuous dark lateral stripe.

DESCRIPTION OF TYPE.—Habitus of the short-arm group. Snout-to-ear, 13 mm.; snout to vent, 75 mm.; ratio, 5.77; scale rows, 37; scales mental-to-vent, 94; undivided subdigital lamellae under longest toe, 16; dorsal scales striated



Extreme left: dorsal and ventral views of *Celestus curtissi*, sp. nov.
Center and extreme right: dorsal and ventral views of *Celestus costatus* (Cope)



but unkeeled; head scales similar to other Hispaniolan forms; upper labials, 9 with angular subocular between 6-7; adpressed limbs do not meet; arm equals distance snout-ear.

Color in preservative: upper surface gray with a few dark flecks posteriorly and on tail; underside cream color with a few scattered dark marblings on throat, anal flap and limbs; dark brown lateral stripe begins at nostril, passes through orbit, over foreleg and disappears on base of tail; lateral stripe about $6\frac{1}{2}$ scales wide at midbody, the upper row particolored, the upper half lighter than dorsum, giving accent to the dark stripe; 3 or 4 light specks in lateral stripe over arm.

TABLE I
MEASUREMENTS OF *Celestus curtissi*, TYPE AND PARATYPES

Catalog No.	Sex	Snout to vent (mm.)	Snout to ear (mm.)	Snout-Vent Snout-Ear	Scale rows	Lamellae
USNM 117337	♂	75	13	5.77	37	16-16
USNM 117338	♂	64	11	5.82	35	15-15
USNM 117266	?	58	10.5	5.52	37	16-15
USNM 117267	♂	68	12	5.67	36	14-15
USNM 117265	J	53	10	5.30	35	16-17
USNM 117268	J	36.5	7	5.22	35	14-14 (?)
C. Grant 75	♀	71	11	6.46	33	15-15

The measurements (Table I) show that the juveniles have heads slightly larger in proportion than the adults, as is to be expected, and that the female has a proportionately longer body. The pattern and squamation are similar in all except the female, which has a narrower lateral stripe and, strangely, fewer scale rows. A possible abnormality in this specimen is the single transverse shield in place of the first pair of chin shields.

Many thanks are due Mr. Anthony Curtiss for his valuable aid in sending specimens to the United States National Museum and the author; Mr. Arthur Loveridge for comparing various celesti with photographs of *C. curtissi*; and Dr. Doris Cochran for the many courtesies extended me during the course of this study.

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2970 SIXTH AVENUE, SAN DIEGO 3, CALIFORNIA.

Herpetological Notes

THE PROPER CITATION FOR CERTAIN SPECIES DESCRIBED BY TSCHUDI.¹—It is readily apparent from a survey of the literature dealing with the herpetofauna of Perú and adjoining areas that most herpetologists are not cognizant of the fact that all of the species bearing a Tschudi name and described in the "Fauna Peruana" were diagnosed in a paper published a year earlier than that work. The mistake seems to have arisen and been perpetuated primarily as a result of inadequate knowledge of the dates of publication of the two works in question on the part of earlier workers. It can now be conclusively shown, however, which of the works was published first, and thereby what the proper citation for the species concerned should be.

The first of these papers was published in Wiegmann's *Archiv für Naturgeschichte* (1845, 11(1): 150-170), by Dr. J. J. de Tschudi, entitled "Reptilium conspectus quae in Republica Peruana reperiuinter et pleraque observata vel collecta sunt in itinere a Dr. J. J. de Tschudi." Tschudi described 8 new genera and 34 new species in this paper, all of which are accompanied by short Latin diagnoses. The above citation is given by Neave (1939-1940, *Nomenclator Zoologicus*, vols. 1-4, London), for all 8 genera, 6 of which have this citation alone. In the citation for the other 2 genera, the "Fauna" is mentioned also. In one case it is cited second, and as being published in 1846; in the other case it is cited first, and as being published in 1845!

The second paper is the much more widely known *Untersuchungen über die Fauna Peruana*, by J. J. von Tschudi, St. Gallen, 1844-46. The title page of the herpetological section reads "Herpetologie bearbeitet von Dr. J. J. von Tschudi. 1845." Tschudi refers to the paper in the *Archiv* in the introduction to this section, and he cited the "Conspectus Reptilium" as the original place of publication of his species in his "Systematische Zusammenstellung" (pp. 5-20). In the remaining portion of the herpetological section, Tschudi described in detail the species diagnosed in the *Archiv*, after first repeating the Latin diagnosis for each species.

In order to establish approximate dates of publication for the two papers, various sources for bibliographic material were checked, with the following results. Tschudi signed his "Conspectus" with the date "Januar. 1845." Each Band of the *Archiv* was published in two numbers at this time (which were without headings or printed designations), and Tschudi's Conspectus appeared in the second number of the erster Band for 1845. This number was received in the Harvard College Library on September 27, 1845, and it can be safely concluded that this article was printed and distributed between January and September of 1845. The herpetological section of the *Fauna Peruana*, on the other hand, although dated 1845, did not appear until some time in 1846. The Catalogue of the books, manuscripts, . . . in the British Museum of Natural History, Vol. V, 1915, p. 2147, points out that the whole of the herpetology and ichthyology parts was issued in 1846. This was determined from reviews appearing in *Isis* for 1846. C. D. Sherborn (1922, *Index Animalium*, Sect. 2, Pt. 1: CXXIV) stated that parts 7-12, which include the text and plates on herpetology, were printed in 1846. J. T. Zimmer (1926, *Field Mus. Nat. Hist., Zool. Series*, XVI, publ. 240: 640) reviews the reports to date concerning the ornithological sections of the *Fauna*, and concludes that all of the descriptive text on birds appeared in 1846 (*ergo*, so also did that on the herpetology). In this connection it is pertinent to point out that the ornithologists have long used the "Conspectus Avium" which Tschudi published in the *Archiv* as the proper citation for the new species described there.

From these facts it seems evident that the proper citation for the species usually ascribed to the *Fauna Peruana* should be *Archiv für Naturgeschichte*, 1845, 11 (1): 150-170.—JAMES A. PETERS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan*.

¹ My sincerest thanks are due Mr. F. Riden Harrell, Museums Librarian, University of Michigan, for innumerable kindnesses in this regard, and Mr. Foster M. Palmer, Harvard College Library, for information concerning the *Archiv*.

NOTES ON SOME TADPOLES FROM SOUTHWESTERN MISSOURI.—While stationed at Camp Crowder, Newton County, Missouri, for several months in 1944–1945, Mr. Harry Roslund assembled a small herpetological collection, which he presented to Carnegie Museum. Tadpoles of five species are included, and are reported upon in the present paper. This material supplies some data on larval variation, and on late autumn occurrence with its correlated possibility of overwintering in the tadpole stage.

Although the collection is small, it provides good examples of several of the difficulties encountered in larval studies. One of these is the often-mentioned but seldom-studied problem of larval variation. Variation in tadpoles involves complex age and growth factors and ecological limitations, as well as geographic differences. It also involves more or less frequent occurrence of atypical or abnormal variants; these are unusually abundant in the present collection. Normal variational limits cannot be defined unless adequate series (population samples) are studied, and variational data are difficult to interpret unless there is a substantial background of comparative literature. These are, of course, familiar problems in work on adult stages, but they are of no less significance in larval work. In addition, study of larvae from critical areas is often hampered by nomenclatorial problems, since taxonomic decisions are usually based only on adult characters. Two examples of this situation are pointed out in the present paper.

These tadpoles undoubtedly fall short of the maximum sizes attained in this area by their respective species, for only one individual, an *Acris*, is near metamorphosis.

Hyla versicolor Le Conte. — CM 23508; Camp Crowder, October 29, 1944. The single tadpole collected measures 20.5+ mm. in total length (tail tip missing) and 11.5 mm. in head and body length. Under normal conditions, metamorphosis probably could not have occurred before mid-November, for the hind leg buds are very small with the joints scarcely indicated. The tooth row formula is the usual 2/3, but the outer two rows on the lower lip are very atypical; the second lower row is divided into three curved parts and the third lower row consists of two short, widely separated bars.

Populations in southwestern Missouri are presumably *H. versicolor versicolor*, but the species is in need of thorough review. The uncertain northward extent of *H. v. chrysocelis* (Smith and Brown, 1947, Proc. Biol. Soc. Wash., 60: 47–50) and the puzzling differences between lowland and upland populations that have been discussed in recent literature indicate that it is unwise to give this tadpole a subspecific allocation.

Acris crepitans blanchardi Harper. — CM 23507(5); Camp Crowder, October 29, 1944. The 5 tadpoles in this series range from about 26 to 30 mm. in total length (tail tips damaged in all except one), and 12 to 14.5 mm. in head and body length. The tooth rows are 2/2 and the labial teeth are widely spaced, as is typical in *Acris*. In one larva, both of the lower tooth rows are asymmetrically divided, in another the second lower row is poorly defined and contains few teeth. The nostrils are conspicuously enlarged, a variation of unknown significance sometimes occurring in tadpoles of *Acris*. In one tadpole with a total length of approximately 27 mm. the hind leg buds are 3 mm. long and are distinctly jointed although the toes are still poorly defined. In the specimen measuring ± 30 mm. in total length, the hind legs are well developed and about 12 mm. long.

This series is too small to indicate definite population characteristics, but comparison with substantial series of *A. crepitans* from southern Louisiana (Orton, 1947, Ann. Carn. Mus., 30: 363–82, 2 pls.) suggests the possibility of trends toward slightly smaller total length and more frequent occurrence of the black tail tip in the Missouri locality. Newton County, Missouri, falls within the range of *A. c. blanchardi*, as defined by Harper (1947, Proc. Biol. Soc. Wash., 60: 39–40), but much more material from additional localities is needed to determine whether there is any subspecific differentiation in the larvae. Until the systematics of the cricket frogs are better known, *A. crepitans* and *A. gryllus* are considered full species.

Rana catesbeiana Shaw.—CM 23704 (24); 3–4 miles south of Noel, McDonald County, Missouri, October 12, 1944. The 24 tadpoles in this series vary from 35 to 78 mm. in total length, 15 to 29.5 mm. in head and body length. They are typical in general morphological characters and in color pattern. The tooth row formula is consistently 2/3, with the exception of one abnormal specimen that lacks the third lower tooth row and has conspicuous irregularities in other rows. None shows any trace of the third upper row that is often present in large larvae of *R. catesbeiana*. All have the typical black-dotted dorsal pattern of this species. On the smallest specimen, a heavily pigmented

blood vessel shows through the distal third of the tail muscle as a dark line above the notochord. This is a useful identification character in young larvae of *catesbeiana*. The tadpoles have small hind leg buds; they are minute cone-like processes in the smaller specimens and in some larger larvae up to a total length of 65 mm. In the majority of specimens in the 59-78 mm. size group, the feet are becoming differentiated and the leg buds have a maximum length of 4 mm.

Rana clamitans Latreille. — CM 23510 (10); Camp Crowder, October 29, 1944. The tadpoles range from 30.5 to 50 mm. in total length, 12 to 18 mm. in head and body length, and are typical in morphology and pigmentation. The tooth row formula is uniformly 2/3, but 2 of the 10 larvae have slight irregularities in position and shape of the tooth rows. The hind leg buds are small, attaining a maximum length of about 3 mm. in 2 specimens with total lengths of 45 and 50 mm.

The tadpoles of *R. clamitans* and *R. catesbeiana* are very similar in most characters and are sometimes difficult to distinguish. The following tentative key may be of assistance:

- A. Beaks with broad black edges, the lower beak usually almost entirely pigmented; nostrils small but very distinct, with well-defined openings; throat usually without heavy dark pigmentation; skin thinner, transparent in preservative so viscera show through (except in specimens near metamorphosis)..... (Leopard frog group)
- B. Beaks with narrow black edges, the lower beak 1/2 or less pigmented; nostrils tiny and inconspicuous, often poorly defined; throat often heavily pigmented; skin thicker, opaque except in young larvae under about 40 mm. total length..... (Bullfrog group)
 - a. Background color greener; dorsal surfaces of head, body, and tail heavily peppered with sharply defined black dots; young larvae (to about 40 mm. total length) with a heavily pigmented blood vessel showing through translucent distal third of tail muscle, forming a conspicuous but obviously internal (rather than dermal) dark line. Second upper tooth row well developed, and a third upper row often present in large larvae. Size larger, reaching total length of about 75-160 mm.....*Rana catesbeiana*
 - b. Background color browner; dorsal pattern mottled or blotched, sometimes tending to be black-dotted; distal tail pattern of young larvae not modified by pigmented internal blood vessels. Second upper tooth row often very short, sometimes absent. Size smaller, reaching total length of about 60-100 mm.....*Rana clamitans*

Rana pipiens Schreber. — CM 23516 (46) collected October 29, 1944; CM 23694 (78) and CM 23695 (10) collected November 5, 1944; all from Camp Crowder. The series under CM 23516 includes 6 very young larvae with total lengths of 8.5 to 13.5 mm. (head and body lengths 4 to 7 mm.). CM 23695 consists of 10 young larvae, 10-14 mm. in total length (5.5-6.5 mm. in head and body length). Other specimens collected on October 29, in the same locality as the tadpoles, included a transforming *R. pipiens*. These extremes in size and developmental condition indicate a prolonged breeding season for leopard frogs in this region.

The series of tadpoles under CM 23516 were taken from a stock pond approximately 20 x 50 feet in size, with a soft mud bottom and a maximum depth of about 4 feet. The tadpoles comprising CM 23694 were obtained from a long pool in an intermittently dry stream bed. These two population samples are in somewhat different states of preservation, but even if one allows for possible difference in degree of shrinkage, the two series show dissimilarities in size and development. In the series collected from the stream pool, the hind leg buds are cone-shaped or elongated in all but one of the specimens above 34 mm. in total length, and are sufficiently developed to show distinct joints in the 2 largest specimens, which measure 44 and 52 mm. in total length (16.5 and 19 mm. in head and body length). The series from the stock pond range upward to 61 mm. in total length (head and body 23). Below a total length of 40 mm. the leg buds are scarcely visible, and in none of the specimens in the series is joint and foot formation evident. These differences are of uncertain significance, but it is possible they are associated with differences in food supply, crowding, or other ecological limitations on growth.

The tooth row formula is basically 2/3, but in CM 23516, 4 specimens of 42 mm. or more in total length have traces of a third row on the upper lip. A surprisingly large number of specimens have various irregularities of the tooth rows, such as crooked, incompletely developed, or asymmetrically divided rows. In CM 23694, 27 (34.6 percent) of the 78 tadpoles have such irregularities. The percentage is still higher in CM 23516. In this series, omitting the 6 very immature larvae under 14 mm. in total length, 21 (52.5 percent) of the remaining 40 specimens have tooth row irregularities.—GRACE L. ORTON, *Scripps Institution of Oceanography, La Jolla, California.*

A PECULIAR BEHAVIOR PATTERN IN A MEXICAN TOAD, *BUFO NAYARITENSIS*, DURING AMPLEXUS.—During the recent (summer, 1949) University of Illinois Natural History Museum field expedition to western México I had an opportunity to observe a large breeding population of *Bufo nayaritensis* Taylor at Tuxpan, Nayarit, on the heights overlooking the Río San Pedro.

On the night of July 8, a torrential downpour commenced at about 11 P.M., and quickly filled the dry roadside ditches and field depressions. At the height of the shower, this species, along with *Smilisca baudinii*, *Pterohyla jodiens* and *Agalychnis dacnicolor*, were in migration through the fields to these newly formed ponds. At 2 A.M., during the light intermittent drizzle that followed the shower, most of the toads were in amplexus at or near the ponds. Heterosexual clasped pairs were found at least 200 yards from the nearest standing water and in these I first noticed a peculiar breeding reaction. Over two dozen amplexant toads were examined and all exhibited a reaction similar to the following example. The male had locked his front legs behind and slightly below the arm insertion of the female in a typical axillary clasp, since both sexes were of approximately the same size. The plantar surface of the male's foot was extended and rested either on the ground or on the dorsal portion of the female's foot (as in the figure). At irregular

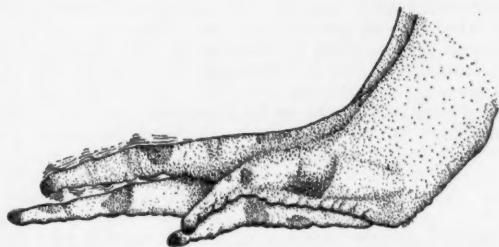


Fig. 1. Digital trepidation in male *Bufo nayaritensis* during amplexus ($4\frac{1}{2}X$). Drawn by B. Marx from field notes by the author.

intervals the body and slanks of the male convulsed and at the same time a low, barely audible chirp was emitted, probably by the female. Immediately after this movement the male's fourth toe vibrated with great rapidity against the ground or the female's foot. The other toes of the hind foot retained contact with the surface. This spasmodic digital trepidation was of short duration (not much more than two seconds); it was repeated at least four or five times, each occurrence precipitated by the body convulsion of the male and the voice. A period of quiescence usually followed, or, upon disturbance, the pair would hop away.

At the ponds, eggs could be seen strung out in single long filaments wound around the grasses and debris. Copulating toads were removed from the water and when placed on the ground the same toe vibration could be elicited. On the morning of July 8 the population of toads at the pond sites was much reduced but many amplexant pairs were still present. The toe-tapping sequence was still in evidence.

I hesitate to interpret this breeding behavior as significant in the structure of *Bufo* populations. The general thesis that closely related species of *Bufo* may possess a specific mechanical isolating breeding behavior that insures the maintenance of genetic isolation is without direct evidence. Interspecific matings occur in many species groups of *Bufo* where the ranges of these closely related members are contiguous or sympatric, because ecological, physiological or reproductive isolating factors break down. Isochronous populations of the *nayaritensis-gemmifer-mazatlanensis* complex, however, show no hybridization with other close sympatric groups. The same is also true of *B. perplexus* and *B. marmoratus*, sibling members of a superspecies group that are for the most part sympatric. Here there is no marked ecological preference and the breeding dates in many localities coincide, yet the different iso-alleles of these two populations, although of similar phenotypic expression, must be maintained by strict, but perhaps not necessarily

mutual, isolating factors. I must presume, then, that some factor quite apart from the influence of environment is involved in the evolution and the maintenance of such different systems of iso-alleles, and it may well be some breeding device such as here recorded in *B. nayaritensis*. At any rate, the absence of hybridization in closely related sympatric species must necessarily mean that there has been effective species isolation.—I. LESTER FIRSCHEIN, *Museum of Natural History, University of Illinois, Urbana, Illinois.*

PHRAGMOSIS AND THE "UNKEN REFLEX" IN A MEXICAN HYLID FROG, *PTERNOHYLA FODIENS*.—Specimens of the casque-headed hylid *Pternohyla fodiens* Boulenger were observed in the field during the summer of 1949 at Tuxpan, Nayarit, and near Guadalajara, Jalisco. At Tuxpan, the species appeared in great numbers following a heavy rain on July 8. Individuals were calling with a distinct "honk, honk" from the margins of ponds but were not breeding. In Jalisco they were found wandering in the fields in nightly forays for food some miles from standing water. No choruses were encountered at the latter locality. Evidently this hylid is terrestrial in habitat and within my experience it is associated mostly with open grassy terrain. Other casque-headed hylids seem to be tree dwellers and possess dilated digital pads well adapted for an arboreal habitat. Barbour (1926, Reptiles and Amphibians, fig. 99) gives a diagrammatic sketch showing how this form may utilize the head casque to close the entrance of its refuge in a tree cavity by deflecting the head. This might obtain in other genera of casque-headed frogs such as *Tripidon* and *Diaglena*. *Corythomantis* was found closing the central lumen of a bromeliad by Lutz (1939, Ann. Acad. Sci. Brazil, 11: 250-252), but I seriously question the use by *Pternohyla* (as Barbour mentions) of tree holes in such a manner. On the contrary, since it was encountered so frequently while foraging on the ground, and since the digital pads are only slightly expanded and hardly functional as adhesive organs, it seems more likely that this frog would make use of vertical burrows already extant in the ground layer; its phragmotic habit would then be effective in blocking the entrance from intruders. Boulenger (1882, Ann. Mag. Nat. Hist., (5) 10: 326-327), however, reports a captive specimen which by use of metatarsal shovels burrowed deeply into loose moss, much as does *Pelobates*. Although the inner metatarsal tubercle in *Pternohyla* is prominent and elongate, it is not sharp-edged and so would hardly facilitate digging. That this hylid does possess the phragmotic reflex is suggested by the position assumed when preserved in 5 per cent formaldehyde. The head in most of the preserved specimens is characteristically flexed at a 90-degree angle to the long axis of the body.

To determine the defense reaction of *Pternohyla*, I jabbed my finger repeatedly at the head of a specimen encountered in the field. Instead of merely ducking its head as some species of *Rana* and *Bufo* would do when subjected to this type of annoyance, the *Pternohyla* assumed an immobile position, a frozen type of flexure much like the "Unken reflex" described and figured by Noble (1931, Biology of the Amphibia: 381, fig. 131). The head was tipped back and the entire body assumed a gentle arch. The eyes were tightly closed. The fore-legs were brought forward and upward and the hind-legs were flexed upward. The toad was thus balanced on its ventral surface and could be rocked back and forth by a gentle touch. When picked up and handled it still maintained this "hypnotic" state. Barbour (*op. cit.*, fig. 121) and Noble (*loc. cit.*) picture *Bombina*, the European fire-bellied toad, in a characteristic pose of the "Unken reflex." They remark that the brightly colored soles and undersides of the toad thus exposed serve as a protective "warning" device since this toad is poisonous. Hinche (1926, Biol. Zentralbl., 46: 296-305) suggests that drab colored species may display this reflex as a means of obstacle avoidance. I suspect that in *Pternohyla* this reaction may not assume the proportion of "usefulness" in dismaying enemies from further attack. No conspicuous coloration is exhibited in the posture assumed, and certainly this species is not poisonous. I found a *Leptodeira annulata polysticta* Günther at Tuxpan, Nayarit, swallowing a *Pternohyla* that struggled and "bleat" as it was being overwhelmed hind quarters first. Evidently it does not maintain its immobile position in this sort of a situation. The reflex is probably initiated only by sudden fright, and is never resorted to, at least in this species, as a definitive protective measure.—I. LESTER FIRSCHEIN, *Museum of Natural History, University of Illinois, Urbana, Illinois.*

A NASAL GLAND IN PLETHODONTID SALAMANDERS.—In studying the nasal region in salamanders I came upon a gland the distribution of which was rather distinctive for certain groups. It was found exclusively in the Plethodontidae and especially in the genus *Plethodon*. It might be called a superficial olfactory gland. Other

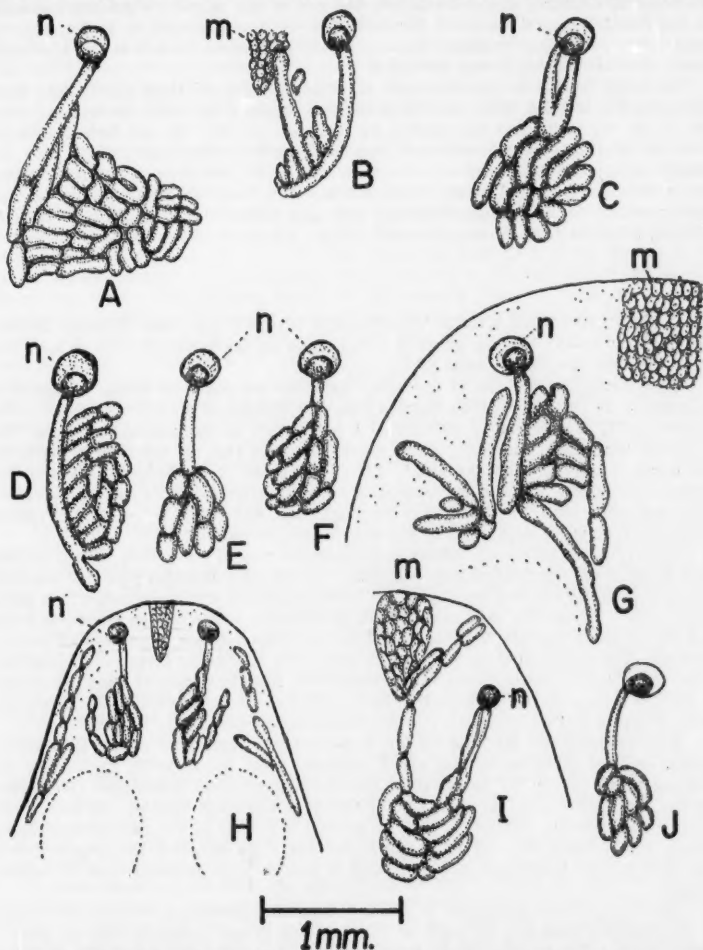


Fig. 1. Superficial nasal gland of some plethodontid salamanders.—m, median nasal gland; n, nostril.—A. *Plethodon g. glutinosus*, adult male.—B. *P. yonahlossee*.—C. *P. idahoensis*.—D. *Bolitoglossa*.—E. *Desmognathus quadrimaculatus*, adult female.—F. *Batrachoseps*, male.—G. *Plethodon g. glutinosus*, female.—H. *Desmognathus fuscus*, young.—I. *Eurycea lucifuga guttolineata*.—J. *D. fuscus*, adult male.

glands described in the nasal region (Seydel, 1895, *Morph. Jahrb.*, 23: 453; Bruner, 1901, *ibid.*, 39: 317) and others within the nasal capsule have been called *glandula nasalis externa* and *interna*.

This superficial gland is located on the top of the skull, not in the skin but under it and just back of the nostrils. It is a compound tubulo-alveolar gland with one or two

ducts leading to the nasal opening on each side of the head. It was found in every one of the following species of *Plethodon*: *cinereus cinereus*, *idahoensis*, *vehiculum*, *glutinosus glutinosus*, *jordani*, *metcalfi*, *welleri*, *yonahlossee*, and *wehrlei*, in adult males and females. It was also found in specimens of *Manculus*, *Pseudotriton*, *Hemidactylum*, *Gyrinophilus*, *Bolitoglossa*, *Ensatina*, and *Batrachoseps*, but not in any species of *Aneides* examined. It was found in several species of *Desmognathus*; in them it seemed to be better developed in the young than in adults. In other young and larvae, as well as the adults and larvae of other families, it was not found.

It would be idle to speculate upon the exact function of these glands until more information is at hand. They may be hedonic, as suggested by Noble (1931, Anat. Rec., 48: 57-58) for plethodont salamanders, but they are certainly not sex limited although they are always connected with the nostrils. Sometimes they extend down into the orbital region; sometimes they extend laterally and slightly ventrally. They have nothing to do with the internasal glands which are found in many species, and they are not strictly mental glands although sometimes extending toward the upper lip.—WILLIAM A. HILTON, Department of Zoology, Pomona College, Claremont, California.

NOTES ON SALAMANDER VOICES.—Dr. Maslin (1950, Univ. Colorado Studies, Ser. Biol., 1: 29-45) has just given us a fine paper on the voices of salamanders. The following notes are supplemental to that paper.

John Burroughs was one of the earlier American naturalists to ascribe a voice to a salamander. In 1881, in *Pepacton* (quoted from The Writings of John Burroughs, Riverby Edition, 1909, 5: Chapter 5) he ascribed a piping note in the autumn woods to "the small red salamander, commonly called lizard," and said that "it makes more music in the woods in autumn than any bird." Clifton F. Hodge (1902, Nature study and life, Boston: 302) says Burroughs' red salamander was "*Spelerpes ruber*" (*Pseudotriton ruber*) but I am quite sure that the animal Burroughs saw was really a "red eft" (*Triturus viridescens*), from his description of the creature and its habitat.

However, it is practically certain that Burroughs was in error, even though he said he saw and heard the creature sing. He says: "... the little musician presently emerged, and, lifting himself up on a small stick, his throat palpitated and the plaintive note again came forth." Those who have often hunted salamanders in the eastern woods, as I did as a boy, must occasionally have seen a red eft thus come out, and observed his throat to palpitate. The important thing is, that Pickering's hyla (the spring peeper, *Hyla crucifer*) often pipes in the autumn woods from concealment, sometimes near at hand. It is easy to imagine a naturalist who obviously knew as little about amphibians as Burroughs did being fooled by one red eft and a peeper hidden amongst the nearby leaves.

But Burroughs was far from the first to write about salamander voices. Liu's recent volume on West China amphibians (1950, Fieldiana: Zool. Mem., 2: 70) quotes Koo Po (writing about 300 A. D.) to the effect that the Chinese giant salamander (*Megalobatrachus davidianus*) cries like an infant! Nothing is said about whether the beast wails under water or above. Maslin mentions an account of the cry of the giant salamander of Japan. I have heard the underwater call of the frog, *Pipa carvalhoi*, but suspect that if this giant aquatic salamander makes a sound, it does so when removed from its natural element.

Maslin quotes my 1930 paper in which I mentioned that Dean Theodore J. Hoover of Stanford had described the bark of *Dicamptodon* to me. Later, in 1937 or 1938, I myself heard a *Dicamptodon* bark. A live specimen, brought into the museum from the Santa Cruz Mountains, was kept alive for several weeks in a terrarium. This individual barked almost every time it was touched or disturbed and I heard it do so many times. The sound was very similar to the bark of a small dog, but of considerably less volume. The mouth was opened with each bark, but not widely. Maslin has demonstrated that this large salamander possesses vocal cords.

When I first began the study of amphibians about 30 years ago, herpetologists used to assure everybody that "salamanders neither bark nor bite," or at least bite hard enough to break the skin. Myers and Maslin (1948, Proc. Biol. Soc. Washington, 61: 130) disposed of the bite, and now Maslin has excised the bark!—GEORGE S. MYERS, Natural History Museum, Stanford University, California.

PECULIAR BEHAVIOR OF INDIGO SNAKES IN CAPTIVITY.¹—On January 5, 1949, an adult female *Drymarchon c. melanurus* (Duméril and Bibron) obtained from a dealer in Brownsville, Texas, was added to the collection at the Audubon Park Zoo in New Orleans, Louisiana. At 12:25 P.M. it was placed in a glass fronted cage containing an adult male *Drymarchon c. couperi* (Holbrook) from a dealer in Silver Springs, Florida, which had been in the collection for a number of months. After several minutes the male *D. c. couperi* approached the female with his neck distended vertically and hovered over her. Beginning at the tail of the female, the male slowly crawled along her entire dorsal surface until the bodies of both snakes were in the same position. The time was 12:40 P.M.

The female was passive to the advances of the male and, apparently attempted to escape him by edging up the front of the glass, but the male again surmounted her and duplicated her curves. The male began anteriorly and rubbed his chin along the dorsal surface of the female, culminating at the tip of the tail. The snakes now began entwining their necks and thrashing about. The male struck the female several times with closed mouth. For the first time the female appeared to take an interest in the procedure and began to entwine her body about the body of the male and to rub her chin along his head. The muscles along a ventrolateral line in both snakes were continually twitching. The male, while still entwined with the female, looped his tail under hers and everted his hemipenes slightly. This apparent attempt to copulate was met with a violent jerk from the female, which threw the two snakes apart. This procedure occurred several times at intervals of about 6 minutes, and each time the two snakes were thrown apart by a violent jerk on the part of the female. While both snakes were in contact, their cloacae were distended and their muscles tense. Undulating movements were evident in the neck region of both snakes, as well as continuous twitching of the ventrolateral muscles. After 19 minutes of comparable action the two snakes separated. For 20 minutes they remained apart, having retreated to opposite sides of the cage. At 1:20 P.M. the male began to rub his chin shields back and forth across the head of the female; this action brought hissing from the female. At 1:27 P.M. the two snakes entwined with open cloacae in contact, and at 1:33 P.M. they separated completely without undue motion. At 1:35 P.M. the male suddenly pursued the female and feigned biting while emitting loud hisses. Again the two snakes entwined and separated as before. After approximately 30 seconds the male moved toward the female, seized her in his jaws at midbody, and held on for 29 seconds. This biting and releasing behavior occurred at about 5-minute intervals for 20 minutes, and ended with both snakes viciously biting each other. At 2:07 P.M. the two snakes separated and began prowling about the cage. They were observed until 3:00 P.M. and no further action took place. Throughout the entire 2 hours and 35 minutes consumed in the display, the biting on the part of the female seemed to be a defensive move, as it occurred only when the male was biting.

On January 8, at 1:52 P.M., the two snakes were again placed in the same cage together. This time the female began rubbing her chin down the male's back, anterior to posterior. The male then followed the same procedure as the female, but was met by violent thrashing. The male overcame the thrashing and pinned the female down with his body. The male rubbed the female's head and body with his chin; then began biting and holding the female with his mouth at midbody and near the base of the tail, releasing only when the female bit him. The male seized the female behind the head and enfolded the female's body in his coils. The male then surmounted the female's body, forming congruous curves, but was shaken off. Five minutes later the male began biting the female, lifting her body off of the cage floor. The two snakes then disengaged and faced each other with opened mouths. The male suddenly struck the female and held on for 20 seconds, but released his hold when bitten violently by the female. The male continued this action for about 20 minutes at 4-minute intervals, always releasing his hold when bitten by the female. During this entire engagement there was a continual curling and uncurling of the ends of the tails and twitching of the muscles in the posterior part of the bodies. At 2:40 P.M. the snakes were separated for fear that the badly lacerated female would be killed.

On January 13, and again on January 15, the two snakes were placed together with results similar to those described.

¹ I wish to extend my thanks to Messrs. Richard E. Etheridge, Lawrence Curtis, and D. Dwight Davis for helpful suggestions in drawing up this paper.

Nearly every aggressive movement was made by the male, the female generally remaining placid unless attacked, and then apparently biting only in self-defense. During the mating "dance" the female seemed disinterested and impassionate.

The female later died, presumably of injuries incurred during her encounters with the male.—DONALD W. TINKLE, 623 Broadway, New Orleans, Louisiana.

AN EXAMPLE OF INTERSPECIFIC MATING IN TOADS.—In his studies on toad hybridization, Blair (1941, Genetics, 26: 398–417) mentions that on one occasion *Bufo woodhousii fowleri* and *Bufo valliceps* were found breeding in the same body of water at Pt. Blank, Texas. He also records the results of a laboratory experiment in which a male *B. valliceps* (Pt. Blank, Texas) and a female *B. terrestris* (Silver Springs, Florida) were mated. Only one percent of the eggs obtained reached the larval stage, and only 7 individuals metamorphosed. The respective species groups to which *B. valliceps* and the *woodhousii-terrestris* complex belong are not closely related, and naturally occurring hybridization between members of the two groups probably has only a minor genetic effect on the southern toad population. Nevertheless, it may be of interest to record an example of interspecific mating observed in southern Louisiana. The toads were collected on June 26, 1945, on the farm property adjoining the campus of Louisiana State University, Baton Rouge, Louisiana. The clasping pair comprised a male *B. valliceps* (CM 24316) and a female *B. woodhousii fowleri* (CM 24317). They were found during a night collecting trip, and were on a dry wagon road about 4 feet from the steep bank of a drainage ditch. The toads were taken to the laboratory but they separated soon after being placed in an aquarium. They were preserved after it seemed unlikely that clasping would be resumed.

Both *B. valliceps* and *B.w. fowleri* are abundant in the vicinity of Baton Rouge, particularly around the small lakes on the campus and the drainage ditches on the adjoining University farm property. Both species were heard calling throughout my three-day stay, and numerous tadpoles of each were collected. Whether hybrids actually occur in this region is unknown, but the opportunity for natural hybridization certainly exists.—GRACE L. ORTON, Scripps Institution of Oceanography, La Jolla, California.

NORTHWARD RANGE EXTENSION OF THE SALAMANDER *TRITURUS SIERRAE*.—So far as is known to the writer the northernmost record for *Triturus sierrae* is near the type locality, specifically that of the paratypes collected near Magalia Dam some 16 miles northeast by east of Chico, Butte County, California.

On a field trip to Squaw Creek, Shasta County, California, during June 12 and 13, 1950, I picked up 7 adult individuals of *T. sierrae*. Found in a typical situation for this species, they were crawling east from the creek in the direction of nearby hills. The animals occurred in two lots about 200 yards apart, the individuals of each lot being taken in an area of about 10 square yards. The altitude was approximately 1400 feet. The locality was 50–75 yards east of Squaw Creek, about 1.25 miles south of Squaw Creek camp, Shasta County, California, some 24 miles northeast of Redding. This is a range extension nearly due north of some 80 miles.

This seemed to be the end of the breeding season for these animals. About 12 more individuals, most of them males in breeding condition, were seen in the bottom of the large, fairly rapid, cold creek. No eggs were found. Water temperatures ranged from 8.5 °C. in early morning to 12.5 °C. at midafternoon. *Hyla regilla* was approaching the end of its breeding season also. Although a careful search was made of several much smaller tributary creeks, none of these salamanders was found.

Characters of 6 of these specimens, examined subsequently in the laboratory, seem definitely those of *Triturus sierrae*, as this species is now diagnosed. There is, however, wide variation in the color of the living specimens. The dorsal color varies from Mars Brown to Blackish Brown (1), and the ventral coloration from Apricot Orange to Sanford's Brown (Ridgway colors). Variation was also evident in the diagnostic light patches on eyelids and snout; in one animal these were indistinct.—JOE GORMAN, Museum of Vertebrate Zoology, University of California, Berkeley, California.

A HERPETOLOGICAL STUDY OF BURNED-OVER AREAS IN DADE COUNTY, FLORIDA.—On a field collecting trip in Dade County, Florida, and the surrounding territory during the months of February, March and April, 1949, we had the opportunity of hunting and studying in areas where the habitats of reptiles and amphibians had been subjected to fires, many of which were started carelessly. All the specimens collected and studied were taken from a limestone ridge area which, before the fire, was covered by thick undergrowth. In the entire area we collected a total of 60 box turtles, *Terrapene c. bauri*; many of these were badly burned. Some of them we dug out of the peat soil where they had burrowed; at least 10 of these had not survived. Two dozen partly burned tortoises were turned loose in the Everglades National Park. We also found 12 specimens of *Crotalus adamanteus*, 2 of which were living.

The following species were taken from an area 6 miles west of Miami along the highway. In the space of 100 feet, we picked up 33 live specimens of *Ophisaurus ventralis*; 24 others were found dead in the burned area. In this region we also found alive 3 specimens of *Opheodrys aestivus*, 4 of *Coluber c. priapus*, 4 of *Thamnophis sirtalis sackenii*, and 6 of *Terrapene c. bauri*. The box turtles were freshly burned and had old scars from former fires. There were also countless numbers of *Hyla squirella* and *H. c. cinerea* that had been destroyed by the fire. Many specimens of *Anolis carolinensis* also did not survive.—LEWIS H. BABBITT and CORINNE H. BABBITT, *Petersham, Massachusetts*.

COURTSHIP AND MATING OF EUMECES EGREGIUS.—On March 13, 1946, while collecting and taking moving pictures at Key West, Florida, I came upon a pair of specimens of *Eumeces egregius* in courtship. The male, which was chasing the female around a palm tree, grabbed her by the neck and dragged her along on the ground for 15 minutes. She broke away and after a moment the male again began the chase, apparently following her scent. After covering 2 feet of ground, he again caught her and dragged her around for 2 minutes longer. After a minute's rest, copulation followed. This lasted 5 minutes, each lizard then going its separate way. The courtship and mating procedure lasted approximately 25 minutes.—LEWIS HALL BABBITT, *Petersham, Massachusetts*.

COLLECTING LIZARDS AT NIGHT UNDER BRIDGES.—During the course of recent field work in México, I accidentally stumbled upon a surprisingly easy means of catching lizards alive and unharmed. The technique is so simple it seemed likely that many persons must have employed it in collecting series of specimens for sale or study. Yet, several colleagues who have had wide experience in arid regions advise me it is new to them, and they urge me to record the method for the benefit of others. Briefly stated, one has but to look under bridges at night.

When Mrs. Conant and I arrived in Monterrey on September 24, 1949, we noted that rain water was standing in shallow pools in a few of the smaller "washes" over which the highway passed. Since we wished to take advantage of the presence of water and since our special objectives, snakes of the genus *Natrix*, are most easily collected after dark, we set out at night, choosing the paved road to Salinas Victoria. We stopped at every bridge and went below each one whether water was visible or not. All were of stone and concrete; they were low, varying from three to twelve feet in height from the bed of the "wash" to the floor of the bridge. We encountered no water snakes, but under the majority of the spans we were surprised to find sleeping specimens of *Sceloporus cyanogenys*, sometimes as many as five or six beneath a single bridge. With the aid of a headlamp they were caught with comparative ease. The chief difficulty was in getting up far enough to reach them under the higher bridges. Virtually all were clinging to the rough surfaces of the stone abutments within a few inches of their tops.

The lizards varied in length from half-grown individuals to large adults that approached the maximum size for the species. Several had concealed themselves partially or almost completely in crevices where the mortar had fallen away or where it had been applied inadequately during construction.

Our catch totalled ten, but it would have been far greater if we had taken pains not to disturb the lizards. A number of them, once they were aroused by our lights, noise, or both, ran out along the abutments and disappeared into the night. Two were preserved for record purposes; all others (after photographs were made) were liberated the following

day, but with the hope of recapturing some of them on our return trip a month later. We did investigate the same bridges again during the night of October 27-28th, but we only saw six and collected five specimens. The temperature, as a result of the first *norte* ("northern storm") of the season, was about 65° F., 20 to 25 degrees lower than on the earlier trip.

The same technique was employed on October 17th under bridges on the highway between Veracruz and Alvarado, and there we obtained 20 of the extremely active and agile *Basiliscus vittatus*. These lizards were hanging heads upward and with their long tails dangling straight downward. A pair of large adults were together under one bridge; all the other lizards were smaller, most of them presumably young of the year, and these were so numerous under one span that I returned to our car with two wedged between each pair of fingers—12 basilisks in all. We saw a total of perhaps 50.

Bridges in arid country offer many inducements to saurians. They provide shelter from the sun and from some types of natural enemies, temperatures are lower beneath them, and moisture is conserved longer than elsewhere on the surface of the ground. Also, insects are attracted to such places, as was exemplified by a concentration of many hundreds of butterflies under and beside a span near Tampico. Moisture apparently was the lure for these lepidopterans, but other insects are attracted by the dung dropped by the cattle that seek welcome shade beneath the highways.

Bats also take advantage of at least some of the bridges. During the evening of September 24th (between Monterrey and Salinas Victoria) we found numbers of them clinging to the abutments of the higher bridges; as many as 50 were counted in a single cluster. They were fairly active, and bats were constantly joining and leaving the groups. Only a few were present during the night of October 27-28th. None was found under any of the same bridges during the daylight hours of September 25th. A specimen that we brought home with us has been identified by Frederick A. Ulmer, Jr., Curator of Mammals at the Philadelphia Zoological Garden, as *Antrozous pallidus*.—ROGER CONANT, *Zoological Society of Philadelphia, Philadelphia 4, Pennsylvania*.

THE OCCURRENCE OF THE LIZARD *GEKKO GEKKO* IN THE COLONY OF HONG KONG.—Shortly after returning the proof of my list of Hong Kong geckoes (Romer, 1950, *COPEIA* (1): 54-55), I was happy to discover that *Gekko gekko* (Linnaeus) is also included in our local herpetofauna. Although this species was known from Kwangtung (Pope, 1935, *The Reptiles of China*: 462), it has never been recorded from anywhere within the Colony of Hong Kong. The fact that such a large and well-known gecko has escaped record so long is not altogether surprising when the locality and nature of its habitat are considered.

Gekko gekko is regularly sold by snake-dealers in the city on Hong Kong Island; it is imported from southern China for the preparation of Chinese wine. If specimens had been found on Hong Kong Island, or even in Kowloon on the mainland, one would have been forced to suppose that they had merely escaped from captivity. The species, however, has been found to occur at Tung Chung on Lan Tao, an entirely rural, largely uncultivated and little-populated island, lying directly west of Hong Kong Island, which it considerably exceeds in size. This remote part of Lan Tao attracts few visitors.

On February 23, 1950, I purchased a live adult *Gekko gekko* from one of the snake-dealers, and on making enquiries regarding its origin, was informed that it had been received from Tung Chung. A few days later I visited that locality with some friends and enquiries on arrival at once revealed that this gecko is well-known to the local Chinese. One live adult specimen was obtained from a woman who had apparently been keeping it to sell in the city. Since time was short we engaged one of the villagers to show us exactly where the geckoes were found, and after an hour or two of stiff climbing, he finally halted on a rocky hillside and pointed out several narrow clefts in some particularly large rocks. It was then only a few minutes before we saw one of these giant geckoes in a cleft in one of the rocks.

The variation in the nature of the habitat of this species is interesting. McCann (1940, *Jour. Bombay Nat. Hist. Soc.*, 41: 764), referring to the species in northern Burma, states that: "They frequent houses, huts and trees and at nights are often seen on fence posts. In forests they live in holes or on the bark of trees." It seems likely that their absence from dwellings and apparent confinement to the rocks on lonely hillsides in this colony may be related to their extermination from other types of habitat.—J. D. ROMER, *C/o. Urban Council, Hong Kong*.

THE CASCADE FROG IN OREGON.—The presence of *Rana cascadae* in Oregon has long been intimated, but there apparently exists only one published record to this effect, referring to "a number (of *Rana cascadae*) from Breitenbush Lake, Marion Co., Ore." collected by J. R. Slater (Wright and Wright, 1949, Handbook of Frogs and Toads: 442). The following records from lakes and streams of the high Cascades of Oregon show that this frog is present at least as far south as the Crater Lake area:

Linn County

- Pamelia Lake trail, $\frac{1}{2}$ mi. east of bridge across Red Creek (3000 ft.)
- Jorn Lake (5050 ft.)
- 0.7 mi. north of upper crossing of North Santiam R., by State Route 222 (3450 ft.)
- Tombstone Prairie, US Route 20 (4000 ft.)

Jefferson County

- Jack Creek, 2 mi. west of confluence with Metolius R. (2900 ft.)
- Suttle Lake (3400 ft.)

Lane County

- Scott Lake (4750 ft.)
- Horse Lake (4950 ft.)
- Salt Creek Falls Forest Camp, State Route 58 (3800 ft.)

Deschutes County

- Tumalo Falls, Tumalo Cr. (5250 ft.)
- Todd Lake (6000 ft.)
- Irish and Taylor Lakes (5500 ft.)

Klamath County

- Odell Cr., 2 mi. south of Davis Lake (4450 ft.)
- Crater Lake National Park, Crater Meadows (approx. 6000 ft.)

The range of *R. cascadae* in Oregon is overlapped to the east by that of *Rana pretiosa luteiventris* and to the west by that of *Rana aurora aurora*. *R. cascadae* can be distinguished from *R. pretiosa* by the following characteristics: heel of hind leg to or beyond external nares (short of nares in *R. pretiosa*); yellow groin (reddish in *R. pretiosa*); underside of legs washed with orange-yellow (salmon-red in *R. pretiosa*); mask present (lacking in *R. pretiosa*); fingers relatively more heavy. Numerous literature records of *Rana p. luteiventris* in lakes and streams of the high Cascades undoubtedly refer to *R. cascadae*. *R. cascadae* differs from *R. aurora* as follows: only yellow mottling in the groin (yellow and red in *R. aurora*); undersides definitely yellowish (reddish in *R. aurora*); fingers relatively more heavy.

Living specimens of *R. cascadae* in Paradise Park, Mount Rainier National Park, elevation 5500 ft., showed close similarity to all Oregon frogs examined in these features: heel to or beyond external nares, fingers relatively stout, buffy to yellow below, groin mottled with yellow, dorsal spots usually large and distinct, skin smooth to moderately rough, and mask present.

A detailed ecologic and taxonomic study, involving the *aurora-cascadae-pretiosa* complex is in progress at the present time.—DONALD G. DUNLAP and ROBERT M. STORM, *Department of Zoology, Oregon State College, Corvallis, Oregon*.

MIGRATION TO THE BREEDING POND BY THE SPOTTED SALAMANDER.

—A study now underway at Ann Arbor, Michigan, in regard to the ecology and breeding habits of *Ambystoma maculatum* (Shaw), has revealed a method by which the spotted salamander finds a breeding pond. Contributors to this study thus far include H. G. Dowling, W. E. Duellman, J. A. Peters, R. Russell and A. Schwartz. It is hoped that this note will stimulate field investigators to watch for this behavior in other localities.

F. N. Blanchard (Am. Nat., 64: 154-167) has shown that heavy rain is the stimulus which causes the spotted salamander to leave its hibernational site and seek a breeding place. In the Ann Arbor area, the breeding place is usually a highly fluctuating pond in or adjacent to a wooded area. Studies on two ponds show that heavy rains cause the formation of an overflow brook which may last for only a few hours after the cessation of the rain. Many pre-nuptial salamanders were found in such overflow brooks. These animals showed a strong, positive rheotropism. Assuming depth of water to be the next stimulus for an obligatory reaction in the reproductive behavioral pattern, it can be seen that the spotted salamander will rapidly congregate in such a pond as described above.—L. C. FINNERAN, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan*.

THE RINGED SALAMANDER, *AMBYSTOMA ANNULATUM*, IN OKLAHOMA.

—*Ambystoma annulatum* Cope is the least known United States ambystomid. Bishop (1943, Handbook of salamanders: 115) reports it from only two localities; one in Missouri and one in Arkansas. A considerable extension of this known range was made by the discovery of a specimen of this species beneath a stone on the west slope of the Cookson hills, 4 miles south of Stillwell, Adair County, Oklahoma (April 9, 1950). This specimen (Univ. Illinois Nat. Hist. Mus. No. 15118), a female with a poorly developed ovarian structure, measures 71 mm. from snout to vent and 145 mm. in total length. There are 13 costal grooves clearly evident and a faint groove in the axilla and in the groin; 4 costal folds between adpressed limbs. Five complete light dorsal bars cross the body, and a bar is present between the orbits involving the upper eyelids. An incomplete diagonal light band is situated on the head back of the eyes. The tail is completely ringed with 7 light bands. Two plantar tubercles are present. The transverse gular fold is a continuous slightly posteriorly curving line without a median indentation as in other species of *Ambystoma*.

Ambystoma annulatum is now known from five localities: Stone County, Camden County (P. W. Smith, 1950, COPEIA (3): 228) and Gasconade County (Anderson, 1950, Herpetologica, 6: 55), all in Missouri; Garland County, Arkansas; and Adair County, Oklahoma.—I. LESTER FIRSCHEIN and LOWELL S. MILLER, Museum of Natural History, University of Illinois, Urbana, Illinois.

DURATION OF THE TADPOLE STAGE OF THE GREENFROG, *RANA CLAMITANS*.—According to Walker (1946, Ohio State Mus. Bull., 1 (3)), the tadpole stage of *Rana clamitans* Latreille extends through the winter, and transformation takes place the following spring or summer. The dates for transformation in Ohio range from May 23 to September 3. Wright and Wright (1949, Handbook of Frogs and Toads) also stated that in the north the tadpoles over-winter, and transform between April and September. That the tadpoles in the south also over-winter has been questioned by the same authors.

On April 28, 1950, a mature female of *R. clamitans* was captured near Columbus, Ohio, and was induced to lay eggs by an injection of anterior pituitary hormone. On April 29, she laid several hundred eggs which were immediately fertilized with sperm taken from a captive male. Later, 30 embryos were picked out and were raised carefully in a large crystallization dish. Meanwhile, a similar number of embryos of *R. pipiens* (the same age) were raised in another dish to serve as a comparison. Sphagnum moss and egg-yolk as suggested by the writer (1950, Science, 112: 539-540) were used as food. It was found that tadpoles of *R. clamitans* grew much slower. One of the tadpoles of *R. pipiens* began to transform on June 30 (62 days after insemination), and the majority of them underwent metamorphosis on July 13 (75 days after insemination). On the other hand, the earliest transformation in *R. clamitans* occurred on July 30 (92 days after insemination), and the majority of the specimens metamorphosed on August 20 (113 days after insemination). In the laboratory, therefore, the duration of the tadpole stage for *R. pipiens* ranges from two to two and one-half months, while that for *R. clamitans* ranges from three to four months. Outdoors, the duration of the tadpole stage of *R. pipiens* is 60 to 80 days as observed by Wright and Wright, and approximates that recorded in the laboratory. The breeding season of *R. clamitans* in central Ohio, as reported by Walker, is from May 7 to July 3, and in northern Ohio it may be prolonged to July 31. In the northern United States, according to Wright and Wright, it breeds from the end of May to mid-August. On the basis of the above data, tadpoles of *R. clamitans* from early breeders should be able to metamorphose during the same year. It is possible in tadpoles from late broods, that transformation is delayed until the next year. In induced ovulation, ovarian eggs of *R. clamitans* are not all expelled at one time, as they are in *R. pipiens*. Very possibly in nature, ovulation occurs in the same individual several times during the summer season. The testes of the male individuals of *R. clamitans* contain more spermatozoa than do those of *R. pipiens*, in the summer season. This correlates with the longer breeding season of the former species.—HAN-PO TING, Department of Zoology and Entomology, Ohio State University, Columbus, Ohio.

Ichthyological Notes

OCCURRENCE OF THE OHIO SHAD, *ALOSA OPIENSIS* EVERMANN, IN EASTERN OKLAHOMA.—The following distribution records of the Ohio shad are available: Evermann (1902, Rept. U. S. Comm. Fish., 1901 (27): 273-288) described the species from specimens taken at the Falls of the Ohio River below Louisville, Kentucky. Evermann summed up the known distribution at that time as follows:

It appears in the Mississippi on the borders of Coahoma County, Mississippi, about the middle of March; in the lower Ohio about a month later (April 20); at Louisville still a little later (April 28 to May 20); and in the Kanawha River at Montgomery, West Virginia, in the latter part of May.

Forbes and Richardson (1920, Fishes of Illinois, Nat. Hist. Ill., 3: 49), Jordan (1929, Man. of Vert. Animals, World Book Company, Yonkers-on-Hudson, N. Y.), and Blatchley (1938, Fishes of Indiana, Nature Publishing Company, Indianapolis, Indiana) merely quote Evermann, and place its distribution as in the Mississippi River and its larger tributaries as far north as Louisville and Pittsburgh. Baker (1939, Rept. Reelfoot Lake Bol. Sta., 3: 8) reported thousands of Ohio shad entering Reelfoot Lake by swimming across the spillway, but this was later shown by Kuhne (1939, Fishes of Tennessee, Tenn. Dept. Conserv., Nashville, Tenn.) to be a misidentification of the skipjack, *Pomolobus chrysochloris*.

A pre-impoundment fish survey of the Wister Reservoir, a flood control impoundment on the Poteau River, Oklahoma, was begun in April, 1949. On May 6, the outlet gates of the dam were closed, and the pool remaining in the stilling basin was seined with a 150-foot bag seine. Two fish, tentatively identified by Hutchens as the Ohio shad, were captured in the first seine haul. Further seine hauls in the same area failed to capture any more of this species. The stilling basin was drained on August 12 and 13, 1949, but none was found among the 1200 fish taken from this pool.

These two specimens of shad were sent to the Museum of Zoology, of the University of Oklahoma, Norman, Oklahoma, for positive identification, and they are now in the collection of this museum. Dr. George A. Moore, Oklahoma A & M College, Stillwater, Oklahoma, during a visit to Norman in November, 1949, carefully examined the specimens and verified the original identification.

If, in Table I, the body measurements are compared, it can be seen that, although the measurements of the specimens from the Poteau River are not in exact agreement with those of the type specimen, they usually fall within the range of measurements for the 10 cotypes.

TABLE I

BODY MEASUREMENTS OF 2 SPECIMENS OF *Alosa ohiensis* TAKEN FROM THE POTEAU RIVER, OKLAHOMA, COMPARED WITH THOSE OF THE TYPE SPECIMEN AND 10 COTYPES

Character	Type Specimen	Cotypes	UOMZ No. 25816	UOMZ No. 25817
Sex	♀	8 ♀, 2 ♂	♀	♂
Standard length (inches)	18	15-18	20.2	17.2
Head in length	4.5	4.2-4.5	4.3	4.0
Depth in length	3.6	3.5-4.4	4.0	3.5
Eye in head	5.5	5.2-5.5	5.5	5.3
Snout in head	4.0	4.0-4.5	4.1	4.0
Maxillary in head	2.1	2.0-2.3	2.2	2.0
Mandible in head	1.87	1.7-1.87	1.8	1.9
Number of dorsal rays	18	14-19	17	18
Number of anal rays	18	18-20	21	22
Number of gill rakers	75	68-75	73	70

The Poteau River, a meandering stream that varies from 50 to 300 feet in width and 3 to 20 feet in depth, rises in the mountains of western Arkansas. It flows northwestward approximately 60 miles and northeastward 68 miles. These fish were captured about 48 miles above the point where the Poteau River empties into the Arkansas River at Fort Smith, Arkansas, and, roughly, another 225 miles from the Mississippi River above Greenville, Mississippi.

When the range of the species is considered, this record is not unusual. However, it is the first published record of the occurrence of the species in Oklahoma.—LYNN HUTCHENS, *U. S. Fish and Wildlife Service, Oklahoma City, Oklahoma*, and GORDON E. HALL, *Department of Zoological Sciences, The University of Oklahoma, Norman, Oklahoma*.

THE CAPTURE OF THE HAGFISH (*MYXINE GLUTINOSA*) IN THE GULF OF ST. LAWRENCE, QUEBEC.¹—According to a comprehensive review of the literature by Bigelow and Schroeder (1948, Mem. Sears Found. Mar. Res., 1: 59–546), the hagfish is only occasionally found north of the Grand Banks. Among northern captures along the American coast could be mentioned the authentic record by Jensen (1926, Rapp. et Proc.-Verb. Cons. Inter. Explor. Mer., 39: 86–102) of a specimen taken in the northern part of Davis Strait (Lat. 66° 37' N. and Long. 56° 37' W.), just south of the Greenland-Baffin Land Ridge, in 450 meters. The presence of the hagfish in western Greenland has been credited repeatedly on the strength of the short remark “rari in mari Groenlandico” by Fabricius (1780, Fauna Groenlandica, VI, Vermes: 266–449), lacking, however, any precision as to the date and locality of capture.

Through the courtesy of Mr. J. Eugène Comeau, Fishery Inspector, we recently received a specimen of the hagfish which we identified as *Myxine glutinosa* Linnaeus. This specimen was taken on August 27, 1949, by Mr. Philippe Desrosiers, Matane, P.Q., at Pointe-de-Monts, along the northern shore of the Gulf of St. Lawrence. The hagfish was removed from a dead cod (*Gadus callarias*), taken on a halibut trawl in 50 fathoms. According to the same fisherman, the hagfish is found rather often in fishes, particularly cod, taken on a hook in this locality.

This interesting record supported well the opinion of Bigelow and Schroeder (*op. cit.*), who stated that: “Type of bottom, temperature and salinity are such that it [*M. glutinosa*] is also to be expected in the deep trough of the Gulf of St. Lawrence, though we found no definite record of it there.”

The following observations were made on the St. Lawrence specimen, after it had been preserved in formalin for about 5 months. All measurements were made on the left side of the specimen. On the right side the gill opening is placed 2 mm. in front of that on the left side.

Total length (from tip of cartilaginous snout to end of tail).....	413 mm.
Distance from tip of snout to gill opening	118 "
Length of gill opening	4 "
Distance from gill opening to cloaca	239 "
Length of cloacal slit	9 "
Distance from cloaca to extremity of tail	42 "
Weight	76.6 g.

The number of mucous pores on the right side of the animal is as follows: 32 in front of the gill opening, 65 from the gill opening to the cloaca, and 9 posterior to the cloaca.

With the presence of *M. glutinosa* in Quebec waters, the number of cyclostome species in this province is now known to be five. The four others are as follows: *Petromyzon marinus*, *Entosphenus lamottenii*, *Ichthyomyzon unicuspis* and *I. fossor*. Information about Quebec Petromyzontidae is given in a previous paper (Vladykov, Quebec Dept. Fish., Contr. 26, 1949: 1–67).—VADIM D. VLADYKOV, *Laboratory of Biology, Department of Fisheries, Quebec, Canada*.

¹ Contribution No. 31, Department of Fisheries, Quebec.

NOTES ON SPAWNING IN AN AQUARIUM BY THE BRIDLED SHINER, *NOTROPIS BIFRENATUS*, WITH COUNTS OF THE EGGS DEPOSITED.—During experiments in which the bridled shiner was induced to breed out of season, it has been possible to observe the spawning act very closely, and to record accurately the number of eggs discharged per mating. Since such data are extremely rare for fishes in general, and for cyprinids in particular, they are recorded here.

Observations of natural spawning by *Notropis bifrenatus* were published by the author (COPELA, 1947 (3): 190) with some reservations as to the details of the culmination of the act itself. Raney's excellent photographs of *Notropis c. cornutus* (Zoologica, 1940, 25: pls. II-IV) had disclosed an infolding of female by male too swift for perception in the field by the unaided eye. However, the impression of a rather undifferentiated culmination in the spawning act of *N. bifrenatus* is now confirmed by many close obser-

TABLE I
SPAWNING FREQUENCY WITH EGG COUNTS, OF A PAIR OF BRIDLED SHINERS,
Notropis bifrenatus, BREEDING IN AN AQUARIUM

Time	Number of Eggs Spawned	Location	Supplementary Notes
3:50	12 approximately	Left rear	First spawning
4:07	8 counted; all	Center	
4:10	12 counted; all	Center	
4:15	6 counted; all	Center	
4:28	15 counted; more fell	Center	
			Female rested on bottom briefly
4:40	6 counted; all	Center	Female on bottom three minutes
4:48	8 counted; more fell	Left rear	Female ate eggs
4:49	15 counted; more fell	Left rear	
4:57	13 counted; more fell	Left rear	Both fish ate eggs
5:05	11 counted; all	Left rear	
5:08	12 counted; all	Right front	Female on bottom three minutes
5:18	8 approximately	Left rear	Female on bottom briefly, twice
5:25	15 counted; all	Right front	Both ate eggs. Female on bottom three minutes
5:38	9 counted; more fell	Left rear	
5:40	6 counted; more fell	Left rear	Female on bottom, briefly
5:45	14 counted; more fell	Left front	Both ate eggs
5:51	9 counted; all	Right rear	
5:53	9 counted; all	Left rear	
6:04	9 counted; all	Left front	
6:25	Still active; but too dark to see details		Both ate eggs

ventions in both 20- and 40-gallon aquaria. Although the long nuptial pursuits typical of this species are restricted by aquarium dimensions, general behavior is similar to that observed in nature. Pursuits usually begin toward the bottom of the tank, but terminate invariably near the water surface; in nature, spawning occurs only close to the surface. Eggs are discharged usually in the corners of aquaria at the top, where the pursuit ends with the quivering of 2 or 3 fish close together. Eggs falling from this height are easily seen by transmitted light, and can be counted as they fall. Usually most or all are eaten before they reach the bottom.

On March 19, 1949, a 42-mm. female and a 44-mm. male, stripped at 12:30 P.M., produced fertile eggs, as noted elsewhere in connection with the report of an experiment. When released into an aquarium devoid of other fish, they lay on the bottom apparently exhausted, until about 3:00 P.M., when they began to move about normally. At 3:50 P.M., they commenced to spawn independently. They were timed with a stop watch, and the eggs were counted as they fell (cf. Table I).

Over a period of 2 hours and 14 minutes (3:50-6:04 P.M.), they spawned 19 times. Confined to a 20-gallon aquarium, they spawned once in one corner, twice in each of two other corners, nine times in the fourth, and five times in open water. They seemed to prefer corners to open water, and the corner favored was that in which a thermostat test tube was suspended, the remainder of the aquarium being free of equipment. At ten of these times all eggs were counted, seven times the count was slightly short of the actual number spawned, and twice it was approximate. According to the figures recorded, the average number of eggs per spawning was 10. Assuming 5 additional eggs for each deficient count, the average number per spawning would be only 12, and this is a generous estimate. The total number spawned during the entire period would then be 232, and adding the 46 eggs stripped earlier in the day, the total number voided that day would amount to 278. No more eggs were seen to fall, although the fish were still showing some activity at 6:25 P.M., after which further observation was prevented by darkness.

In a 44-mm. female collected during the normal spawning period, the diameters of all eggs, from one ovary, which contained any yolk were measured by the author (1948, Am. Midl. Nat., 39 (1): 91). They numbered 1,055, ranging from 0.18 mm. to 0.81 mm. in diameter. Doubling this figure to allow for the other ovary gives an estimate of 2,110 eggs in different stages of yolk accumulation. However, it was found (*loc. cit.*) that only eggs about 0.6 mm. in diameter and larger were sufficiently developed to possess a micropyle, i.e., to be functionally mature. In the same ovary, the number of eggs at and above 0.6 mm. in diameter was 130. Doubling this to account for the other ovary gives an estimate of 260 eggs presumably about ready to be spawned, a figure very close to 278, the approximate number voided in one day by the female considered here. This leaves an estimated 1850 eggs in various stages of yolk accumulation remaining in the ovaries. If all these were to mature during successive intervals so as to produce the same quota each time, this would afford seven more different spawning days. At present no data are available to confirm or deny this possibility, yet it is clear that spawning in the aquarium among the fish as a group is definitely intermittent, and apparently dependent upon the readiness of the females, since male breeding behavior is rather sustained.—ROBERT W. HARRINGTON, JR., *Biology Dept., Trinity College, Hartford 6, Connecticut.*

NEW RECORDS FOR MARINE FISHES FROM SOUTHEASTERN ALASKA.—

An examination of biological material collected in trawling operations by the Fish and Wildlife vessel *John H. Cobb* on its recent exploratory trip to southeastern Alaska yielded three new distributional records, as follows:

Two black skates, *Raja kincaidii*, were taken March 26, 1950, in 220 fathoms, near Luck Point, Clarence Strait. The fish, one male and one female, were approximately 26 inches long. This catch extends the known northern range of the species from British Columbia to waters of southeastern Alaska.

Five specimens of *Leuroglossus stilbius*, a deep water, smelt-like fish of the family Argentinidae, were taken on March 26, 1950, in 220 fathoms, also near Luck Point; 2 of these were in spawning condition. The fish were 3 to 5 inches long. Records of this species are known from California in deep water and from Bering Sea. This represents the first record of these fish in the waters of southeastern Alaska.

Numerous specimens of the pale eel pout, *Lycodapus mandibularis*, were taken in 220 fathoms off Ratz Point in Clarence Strait on March 27, 1950. This record extends the known northern range of this species from the Queen Charlotte Islands to the Clarence Strait region.

The above specimens have been deposited in the collection of the University of Washington School of Fisheries.—DAYTON L. ALVERSON, *U. S. Fish and Wildlife Service, 2725 Montlake Blvd., Seattle 2, Washington.*

ADDITIONAL REPORTS OF LAMPREYS FROM TEXAS.—In their revision of the lampreys of the genus *Ichthyomyzon* (1937, Misc. Publ. Mus. Zool. Univ. Mich., 35: 44) Hubbs and Trautman presented a distributional map of the parasitic western lamprey *I. castaneus*, and its non-parasitic counterpart *I. gagei*. This map showed that these species occur in the Neches and Sabine rivers of eastern Texas, but no specimens of either species were recorded from Texas. Subsequently, Bailey (COPEIA, 1947: 146) reported an adult specimen of *I. gagei* from Turkey Creek, Nacogdoches County, in the middle Neches watershed, and gave measurements of his specimen. Recently, Toole (1950, Texas Game and Fish, 8(4): 15) reported that Clark Hubbs also had collected *I. gagei* from Nacogdoches County, and that a parasitic lamprey, provisionally identified as *I. castaneus*, was sent to Toole by Paul Whaley of Marshall, who caught it in Caddo Lake. This lake is on the Texas-Louisiana border in the Red River watershed. No measurements were given for these specimens.

To these reports I wish to add the following lamprey records. A mature female of *I. gagei* (Texas A. and M. Cat. No. A-1-b-4, spec. No. 1) taken by graduate student Richard B. Davis in a small stream 5 miles west of Woodville, Tyler County, on U. S. Highway 190, March 17, 1950. Three specimens were noticed in the stream apparently preparing to spawn, but only this one was captured, as the others disappeared rapidly when approached. The following measurements of this lamprey, which is 166 mm. long, are expressed in thousandths of the total length: Tail length, 302; body depth, 66; eye length, 9; snout length, 53; disk length, 44; total distance between gill openings, 102. On comparing these measurements with the average values of eleven specimens of *gagei* recorded by Hubbs and Trautman (*loc. cit.*) from other parts of the range, the south Texas specimen is seen to be longer and thinner and has a shorter eye, snout and disk. In addition, the lingual lamina is more distinctly bilobed. In these features it resembles closely the Texas specimen described by Bailey (*loc. cit.*), but in all other respects it agrees with typical specimens of *I. gagei*.

Two immature specimens of *I. castaneus* were sent to Texas A. and M. College. The larger one (Cat. No. A-1-b-3, spec. No. 1) was found by Wayman V. Wilson of Atlanta, Texas, on a chain pickerel (*Esox niger*) caught by him in Smith Slough, Caddo Lake, March 13, 1950. The smaller specimen (Cat. No. A-1-b-2, spec. No. 1) was sent to me by Paul Whaley of Marshall, who caught it on a bass in Caddo Lake, March 20, 1950. The total lengths and body proportions of these two specimens expressed in thousandths of the total length, are: Total length 165.6 mm; tail length, 248; body depth, 63; eye length, 11; snout length, 101; disk length, 79; total distance between gill openings, 102. Total length, 141.0; tail length, 277; body depth, 78; eye length, 8; snout length, 106; disk length, 94; total distance between gill openings, 97.

These measurements are within the limits of range of variation of 9 specimens from the lower Mississippi, as reported by Hubbs and Trautman, except for the tail length of the larger specimen, which is exceptionally short. The two specimens agree with those from the lower Mississippi in having the body less deep, a smaller eye, and a longer snout, characters that distinguish the southern members from those in the more northerly part of the range.—FRANK T. KNAPP, *Department of Wildlife Management, A. and M. College of Texas, College Station, Texas.*

NORTHWARD DISPERSAL OF WARM-WATER MARINE FISHES IN SOUTHERN NEW ENGLAND DURING THE SUMMER OF 1949.—Record high temperatures that prevailed throughout the eastern seaboard states in 1949, especially in the summer months, were probably a major factor in the appearance in the coastal waters of Rhode Island and southern Massachusetts of numerous forms of marine life that typically occur in semi-tropical or tropical environments. The following list of fishes in this category has been compiled from data furnished by Mrs. Charles J. Fish of the Narragansett Marine Laboratory, Rhode Island, from specimens brought to the Fish and Wildlife Service laboratory at Woods Hole, Massachusetts, by commercial and sports fishermen of the Cape Cod area, and by personal observations.

Gymnura altavela (Linnaeus), butterfly ray.—Very rare on the Atlantic Coast, a single specimen once having been recorded from Woods Hole, Massachusetts. A member of this warm-water species measuring 4 feet across the wings was taken at Point Judith, Rhode Island, in August.

Synodus foetens (Linnaeus), lizard fish.—Rare north of the Carolinas, this species was relatively abundant during mid-summer along the coast and in various bays and coves of southern New England. Three specimens brought to the Woods Hole laboratory for identification were 15.2 cms., 17.8 cms., and 22.5 cms. in total length. They were taken by sport fishermen who related that each fish struck savagely but fought with short-lived energy. One was caught on a piece of squid during surf-fishing operations off Craigville Beach, Hyannis, Massachusetts; one was caught on a Japanese feather lure at Osterville, Massachusetts; and the other (one of 4 caught) hit a trolled fluted spoon off Monument Beach, Buzzards Bay, Massachusetts. In Wickford Harbor, Rhode Island, one lizard fish leaped into a skiff while in frenzied pursuit of silversides. Large numbers of this species were observed here, voraciously feeding on silversides and small menhaden. The lizard fish, which has the same general shape and feeding habits as the barracuda, is no doubt often mistaken for that predator. Several rumors that barracuda had been caught by anglers throughout this area were definitely traced to *S. foetens*.

Coryphaena hippurus (Linnaeus), dolphin.—Heretofore appearing off the southern New England coast as an occasional tropical straggler, many dolphin were observed during mid-summer in Block Island Sound off Point Judith, Rhode Island, and in the vicinity of No Man's Land off the coast of Massachusetts, where numbers were taken by sport fishermen on various lures. In addition, 6 immature dolphin, averaging 40 cms. fork length, were taken in mid-August from a fish trap a quarter of a mile offshore in lower Buzzards Bay, Massachusetts. These colorful fish were kept alive for several days in our Woods Hole laboratory and were a source of considerable interest.

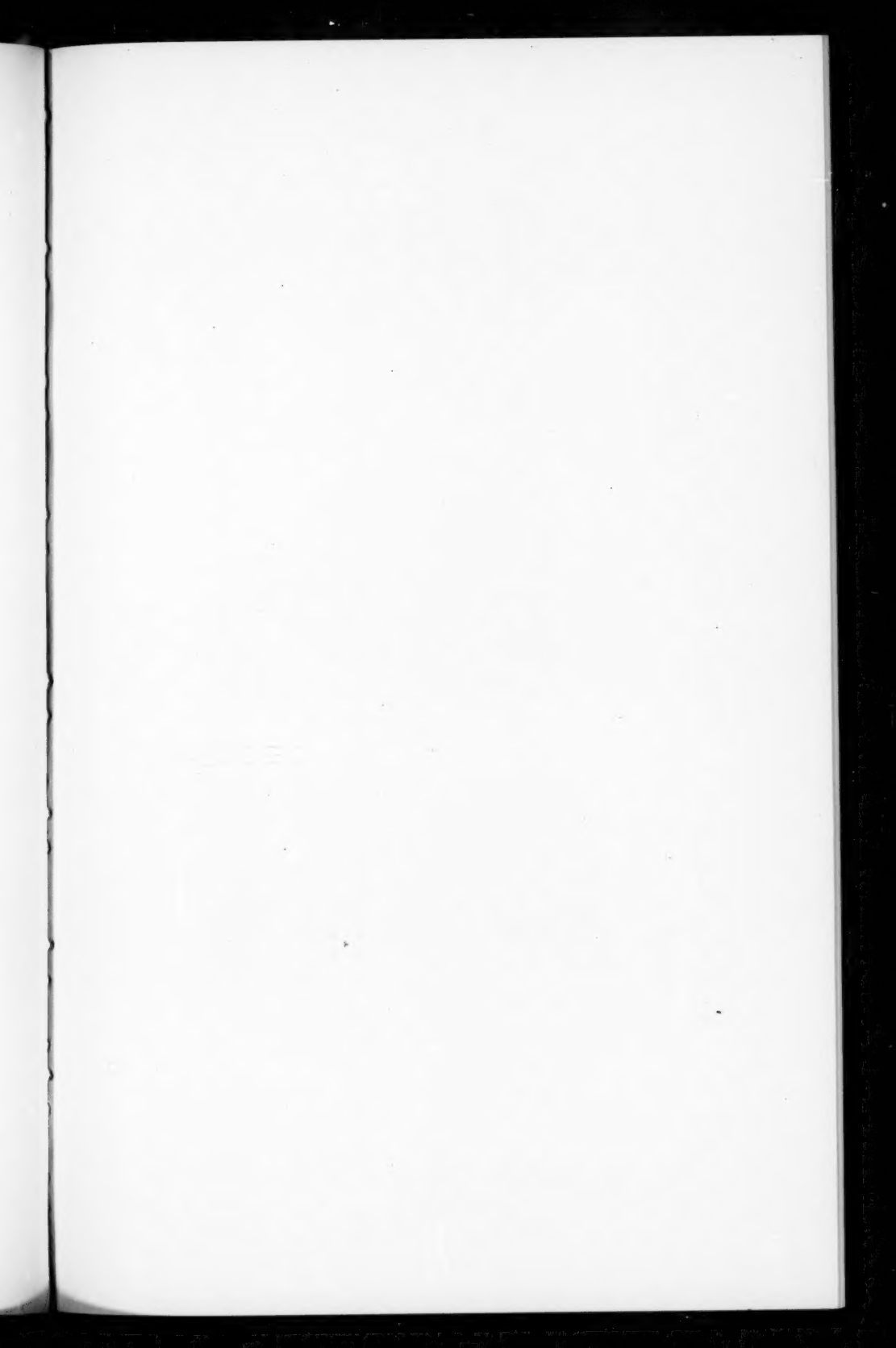
Peprilus alepidotus (Linnaeus), harvest fish.—Uncommon north of New Jersey, a 23.5-cm. (fork length) specimen was caught off Race Point, Massachusetts (off the tip of Cape Cod just north of Provincetown), in October by a commercial dragger. Other summer records from the Gulf of Maine are cited by Bigelow and Schroeder (1936, Bull. U. S. Bur. Fish., 48: 333).

Auxis thazard (Lacépède), frigate mackerel.—Erratic in its migrations, known from all warm seas, and only rarely reaching our coast line, the frigate mackerel was present in great numbers in the vicinity of Point Judith during mid-August. According to reliable observers, these fish "fairly swarmed" in huge schools. Many were caught by commercial fishermen (largely in traps), and, although usually considered to be an inferior food fish, they sold well.

Scomberomorus maculatus (Mitchill), spanish mackerel.—Not common in Cape Cod waters even in summer, a 61.0-cm. specimen (fork length) was taken on October 16, 1949, in North Bay, Cotuit, Massachusetts.—EDGAR L. ARNOLD, JR., U.S. Fish and Wildlife Service, Woods Hole, Massachusetts.

PATTERN DEVELOPMENT IN THE CHAETODONT FISH *POMACANTHUS ANNULARIS* (BLOCH), WITH A NOTE ON THE STATUS OF *EUXIPHIPOPS FRASER-BRUNNER*.—In my revision of the pomacanthine fishes (Proc. Zool. Soc. London, 1933 (3): 543-599) I pointed out that the pattern change during development which was well-known in American species of *Pomacanthus* was to be found also in the Indo-Pacific members of the genus. This I was able to demonstrate with more or less adequate material for all the species except *P. annularis* (Bloch), of which I was able to see only adult examples.

It was, therefore, of great interest to me when, while looking through a series of colored drawings made by Mr. E. Banks on the coast of Sarawak, I found therein sketches



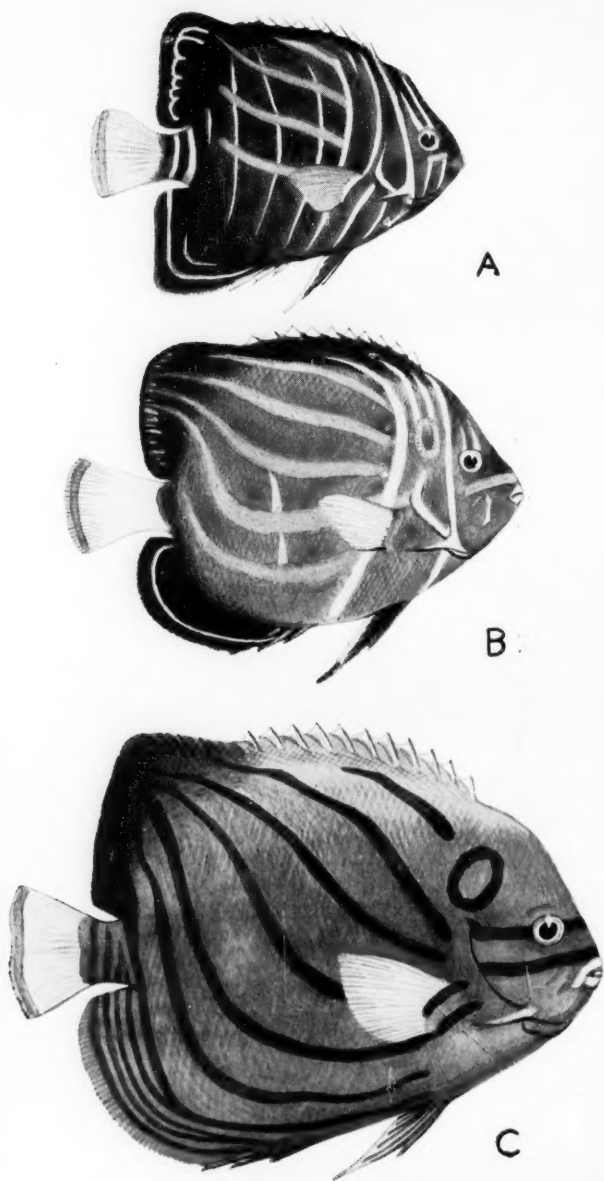


Fig. 1. Three ontogenetic stages of *Pomacanthus annularis*.

of *Pomacanthus annularis* which represented transitional stages in pattern development very similar to those which I had already recorded for *P. imperator*.

Mr. Banks has generously allowed me to make the accompanying illustration from his drawings, and to describe the color changes he has faithfully depicted. I would like to express here my gratitude for the opportunity.

The original sketches were drawn at different times under different conditions, not to any particular scale, and the actual lengths were not recorded. The relative sizes shown in my figure are therefore only approximate, on verbal information supplied by Mr. Banks.

No completely juvenile stage is depicted, but enough evidence is present to show that it resembles that of *P. maculosus* more than others of the genus. This is shown particularly in the fact that the last 2 pale transverse stripes, crossing the caudal peduncle, are continued downwards onto the anal fin and curve forwards as submarginal stripes. There are 2 stripes passing from the occiput through the eye across the cheek, and 12 succeeding stripes, which are more vertical and more irregular than in such species as *P. semicirculatus* or *P. chrysurus*. In our young example of *P. maculosus* the ocular stripe (or stripes) is not visible, but the arrangement of the remaining bands is very similar.

The pattern development of *Pomacanthus annularis* evidently progresses in much the same way as that described for others such as *P. imperator* and *P. semicirculatus*. The adult pattern appears as the juvenile pattern breaks up and fades, so that intermediate specimens show parts of both patterns overlying and interfering with each other.

In Fig. 1, stage A is the youngest, still showing most of the transverse stripes, which are pale blue on a brown ground, the head a little darker brown, the dorsal, anal and pelvic fins black. The caudal fin is white, with a submarginal band of golden yellow narrowly edged by black, and the extreme margin transparent; pectoral fin yellowish; iris yellow. In this specimen the 2 ocular stripes are already interrupted, and joined below the eye by the beginning of the horizontal, darker blue bar which will be a feature of the adult. On the upper part of the side 4 oblique, darker blue bands overlie the juvenile stripes, and are easily identified as the upper 4 adult bands. Note that the juvenile preopercular band passes along the edge of the spinous dorsal fin, while one across the breast is continued as the border of the pelvic.

Stage B shows the adult pattern much further developed at the expense of the juvenile pattern. The transverse stripes (almost white in the colored sketch) are almost entirely lost on the side of the body, while the ocular bands are much reduced. The horizontal bar below the eye has extended, the temporal annulus has appeared, and the bands on the side are more greatly developed. The body is golden brown, paler than in stage A, but still darker in tone than the blue bands.

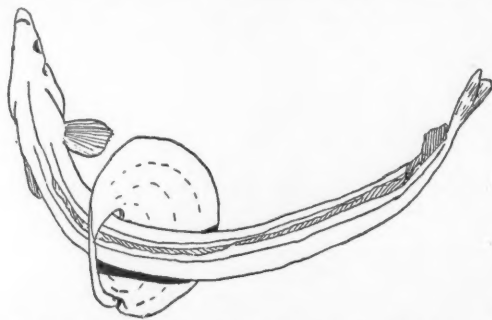
Stage C is the adult, very similar to the one shown in my earlier paper. Here the pale transverse stripes are lost entirely, and the blue bands are darker than the golden-brown ground color; a horizontal band across the eye has appeared, and the dorsal and anal fins are no longer black. The soft dorsal fin is largely deep maroon red, the spinous part and the anal are golden brown. This fish was very likely a good deal larger, relative to the others, than shown here, but this is of small importance, since the pattern is indicative of a developmental stage, not of size. A specimen in a poor environment will probably reach the adult stage at a smaller size but a greater age than one in more favorable conditions.

While on the subject of the pomacanthine fishes, it is desirable to make clear the status of the name of another genus of the group. This was defined by me, in the revision already quoted, under the name *Heteropyge*. Two subgenera were recognized, the second receiving the name *Arusetta*. Later it was found that *Heteropyge* was preoccupied, and the name *Euxiphipops* was proposed by me (COPELA, 1934: 192) to replace it as the name of the genus.

This, of course, was incorrect procedure, since the name *Arusetta* was already available within the genus.

Therefore, it must now be made clear that the genus as defined must take the name *Arusetta*, with *Chaetodon asfur* Forskål, 1775, as type, while *Euxiphipops* (replacing *Heteropyge*), with *Holacanthus xanthometopon* Bleeker as type, has only subgeneric rank.—A. FRASER-BRUNNER, *British Museum (Natural History)*, London, England.

THE UNUSUAL BEHAVIOR OF A SAND LAUNCE.—To the many hazards which the sand lance, *Ammodytes americanus* DeKay, must face in its near-shore habitat may be added a broken clam shell. Near the mouth of the Ogunquit River at Ogunquit, Maine, this slender fish is found in quantity, often in large schools. On June 23, 1950, a lone specimen was seen swimming about in the river at nearly low tide and attempting to burrow in the bottom sand. Swimming and burrowing were greatly hampered because the fish had passed part way through an irregular hole in an empty valve of the soft-shelled clam, *Mya arenaria* Linnaeus, and the shell was firmly collared about the fish approximately 2 inches from the anterior end. The specimen was easily captured by hand and was



preserved in the field. The struggles of the fish failed to release it from its self-imposed impediment. The accompanying sketch was made from a photograph of the preserved specimen. Since this species actively dives in and out of the sand, it may have been that the fish on exiting from the sand had passed through the small perforation in a shell lying on the bottom.—JAMES M. MOULTON, *The Biological Laboratories, Harvard University, Cambridge 38, Massachusetts.*

BEHAVIORISM IN FISHES.—There seems to be a growing school of thought that schooling in fishes must be accounted for by purely mechanical reactions, leaving out any trace of psychological reason.

Dr. James E. Morrow, Jr., in the March, 1948 issue of the Quarterly Review of Biology, stated: "This phenomenon [schooling], if considered as a conscious 'desire' to be close to . . . a companion, at once becomes impossible of further elucidation. Such an interpretation is, therefore, to be avoided." Dr. Morrow forbids attributing any vestige of reason in the schooling of fish. Jacksnipe maneuver in flocks with the most amazing precision, outdoing fish in speed and accuracy. Is this flocking of birds equally mechanical with the schooling of fish?

Mr. James W. Atz, in the August, 1949 issue of *Zoologica*, subscribes to a mechanical interpretation of schooling when he states: ". . . fishes live in a world physically and psychologically utterly different from our own . . ." It seems to me that fishes live in a world that is physically identical to ours and that psychologically they differ from us in degree only. Just where does reason stop if we trace it down the scale from man to bird to fish?

An instance of lack of knowing ones fish is illustrated by Gudger in *Zoologica* (August, 1949) and repeated by Atz in *Animal Kingdom* (Sept.-Oct., 1949), when they failed to explain the alignment of trout, calling it "remarkable" and stating that "no definite explanation . . . has ever been brought forward."

The illustration shows that the bottom of the stream was riffled with wave-like depressions at right angles to the flow. It is evident that the trout were maintaining their position over the troughs, or deeper water. The new school of thought on this subject might be that the alignment was purely mechanical and without volition. Trout like to remain in deep water. Since no deep pools were available in this instance the

trout sought the deepest water available, which was in the troughs of the riffles. A second reason for the alignment is as purely mechanical as is the soaring of a condor or a man in a glider on an ascending air column, not because they could not help it, but because they have sufficient intelligence to use it. In this case it is the fact that the swift current of the stream follows the vertical contours of the riffles, leaving a slightly less rapid flow over the deepest part of the troughs. The trout are efficient enough to select the place where a minimum of effort will keep them stationary in relation to the bottom.—CHAPMAN GRANT, 2970 Sixth Ave., San Diego 3, California.

DESCRIPTION OF *SALVELINUS ALPINUS* (LINNAEUS) FROM ICELAND.—

Through the courtesy of Dr. V. Landa, a member of the Czechoslovakian Arctic Expedition of 1948, I have received 3 specimens of the Alpine charr, which I have compared with the descriptions in the works of Berg (1923, *Les poissons des eaux douces de la Russie*, ed. 2, in Russian. Moskva-Leningrad; 1932, *Faune de l'URSS et des Pays Limitrophes*, ed. 3, pt. 1, in Russian. Leningrad), Günther (1866, *Cat. of fishes in the Brit. Mus.*, 6: 1-368), Smitt (1886, *Kongl. Svenska Vetenskaps-Akademiens Handlingar*, Bd. 21 (8): text, 3-290; 1887, atlas: *Tabulae metricae* + 6 pls.), and the keys in Suskin

TABLE I
PROPORTIONATE MEASUREMENTS OF THREE SPECIMENS OF *Salvelinus alpinus*

Specimen number	1	2	3
Standard length in mm.	199	201	204
In thousandths of the standard length:			
Head length	200	236	216
Depth	—	150	128
Body, greatest depth	174	185	187
Least depth	75	70	74
Tip of snout to dorsal origin	450	451	445
Tip of snout to pelvic insertion	523	535	489
Tip of snout to anal origin	736	720	710
Caudal peduncle, length	171	176	182
Pectoral insertion to pelvic insertion	322	315	261
Pelvic insertion to anal origin	216	186	212
Dorsal fin, length	95	90	103
Anal fin, length	86	80	79
Pectoral fin, length	151	156	157
Pelvic fin, length	111	115	104
Caudal fin,* length of shortest ray	—	75	59
In thousandths of the head length:			
Snout, length	263	275	277
Eye, diameter	226	190	205
Interorbital, width	263	260	275
Internarial, width	125	148	130
Postorbital, length	540	591	594
Preopercular length †	690	667	662
Maxilla, length	351	412	354
width	87	84	102
End of maxilla to posterior margin of preopercle	376	317	320
Subopercle, length	250	253	274
Head, depth	—	635	652
Depth over eyes †	690	665	664
Head, width	552	465	465
Sex	?	♀	♀

* The longest rays of caudal were destroyed, unfortunately, in all specimens.

† See text

and Beling (1923, *Opredelitel ryb presnovodnykh i morskikh evropejskoj Rossii*, in Russian. Leningrad). The fish were collected on July 18, 1948, in Lake Reydarvatn, which was formed, according to the collector, by separation from a fjörd. Lying 325 meters above sea level, its outlet is the Grimea River, which is a tributary to Borgafjörd, north of the capital city of Reykjavik. Coloration of living specimens is greenish, the dorsal part blackish, the belly lighter. In formalin, they are greyish, with light spots on the sides. Proportionate measurements are given in Table I.

The preopercular length is measured from the anterior end of the maxillary to the posterior margin of the preopercle. The width represents the greatest width. The depth

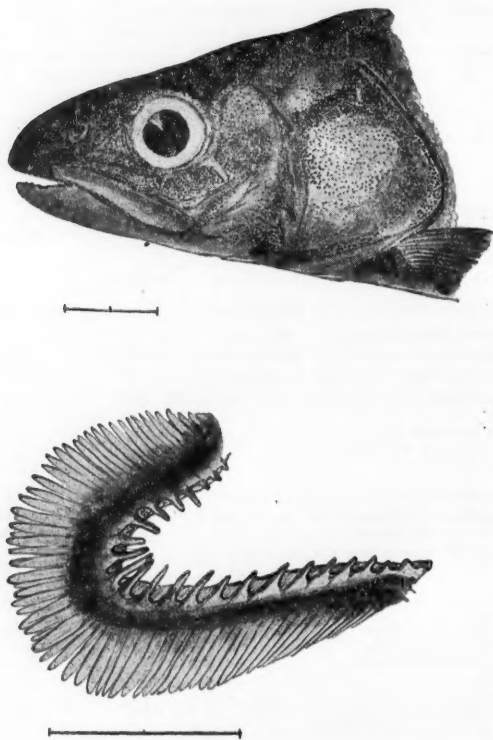


Fig. 1. Head and gill arch of *Salvelinus alpinus*—specimen No. 2 in Table I. Drawing by author. The horizontal line in both figures represents 10 mm.

of head over the eyes is measured along a vertical through the pupil. The standard length is the distance from the tip of snout to the posterior margin of the lateral line scales on the base of the caudal fin (see Schultz, 1936, Univ. of Wash. Publ. in Biology, 2 (4): 115, fig. 7, and 134, fig. 27). There are 14–16 scales in one-tenth of the lateral line and 18–20 scales in the row from the posterior base of the adipose fin to the lateral line. Gill rakers 23–25. Pyloric caeca number 36–40. Dorsal rays are iii 9 and anal rays iii 8 in all, the last double ray counted as one. Pelvic ray i 8.—OTA OLIVA, *Department of Hydrobiology and Ichthyology, Charles University, Prague, Czechoslovakia.*

NOTES ON THE SIZE OF MENHADEN TAKEN IN MAINE DURING 1949.—During 1949, over 5,000,000 pounds of menhaden, *Brevoortia tyrannus* (Latrobe), were caught off the Maine coast, compared to 145,000 pounds in 1948 and 14,000 pounds in 1947. The revival of this fishery after a lapse of twenty years enabled us to collect some original data on the size and maturity of this species.

We obtained five samples of menhaden during the 1949 season, but we were unable to determine the sex in two samples because of decomposition. The other three samples were suitable for sex determination, and from them we obtained the data on male and female lengths (standard lengths from the tip of the lower jaw to the posterior end of the scale row, in millimeters) as shown in Table I. To change this standard length to the length measurement from tip of lower jaw to fork of the caudal fin, a conversion factor of 1.0459 can be employed. A *t* test of the lengths of the two sexes shows that in each sample a significant difference exists between the male and female menhaden lengths, for the *P* value in each case is less than 0.01.

The lengths of all the fish in each of the five samples are compared as shown in Table II. By means of the *t* test, we have compared the lengths of the fish in each sample with those of each of the other four samples. The lengths of the fish in the Boothbay Harbor sample are significantly larger than those of the other four samples, for the *P* value is less than 0.01 in each of the four comparisons. Comparisons of the lengths of the fish in the four other samples show no significant difference between samples. The large size of the fish has always been characteristic of the schools of menhaden occurring in the Gulf of Maine (Hildebrand, 1948, Smith. Misc. Coll., 107 (18): 10).

TABLE I

Date	Locality	Males				Females			
		Number	Range	Mean	σ^*	Number	Range	Mean	σ^*
Aug. 4	Boothbay Hbr., Me.	29	300-329	315.2	8.21	71	304-357	325.3	9.44
Sept. 7	Casco Bay, Me.	35	291-322	311.4	7.27	65	296-349	319.6	11.77
Sept. 14	Barnstable, Mass.	40	272-325	309.0	10.16	60	283-353	321.2	13.16

* σ = standard deviation

TABLE II

Date	Locality	Number	Range	Mean	σ^*
July 19	Casco Bay, Me.	100	291-342	316.7	10.61
July 29	—do—	100	295-352	317.9	9.92
Aug. 4	Boothbay Hbr., Me.	100	300-357	322.4	10.17
Sept. 7	Casco Bay, Me.	100	291-349	316.7	10.80
Sept. 14	Barnstable, Mass.	100	272-353	316.3	13.67

* σ = standard deviation

Some observations were also made of the sexual condition of the female fish. In the August 4 sample, 20 of the 71 females had already spawned, while the other 51 had well developed ovaries. The September 7 sample had 50 spawned-out females, 11 with large ovaries and 4 with undeveloped ovaries. The September 14 sample had 37 spawned-out females, 20 with fully developed ovaries containing dead eggs, and 2 with undeveloped ovaries. No males or females were seen with the sex products in the "running" condition. Fishermen reported that spawning occurred during the summer in Casco Bay, but we cannot verify their statements.

Our capture of small menhaden in a herring weir in the Sheepscot River during December 5, 6, 9, and 11 may be evidence that spawning occurred in Maine waters. Forty-three fish ranged in length from 52 to 95 mm., with a mean of 77.3 mm. and a standard deviation of the mean of 11.71 mm. Several other small fish were seen on December 31 in another Sheepscot weir. These small menhaden were living in waters with temperatures of 40 to 46 degrees. The fate of these small fish, with the advent of colder water, is problematical. Those in Maine waters during the winter may perish; however, it is possible that most of the young ones may have returned to more southern waters.

If spawning is successful, will an independent population of menhaden be established in Maine waters, or will the fishery always have to rely, as in the past, on the sporadic migrations of the large mature fish from the south? There are no answers to these questions. Our knowledge of the biology and habits of this species is extremely meager, even though it is the most important, in terms of poundage, of all the commercial species on the Atlantic coast of North America.—LESLIE W. SCATTERGOOD and PARKER S. TREFFETHEN, *U. S. Fish and Wildlife Service*, and GARETH W. COFFIN, *Maine Sardine Packers Association, Boothbay Harbor, Maine*.

ANOMALIES IN TWO SPECIES OF CENTRARCHID FISHES FROM FLORIDA.—During the course of a study of the black crappie, *Pomoxis nigro-maculatus* (LeSueur), in Orange Lake, Alachua County, Florida, in 1947-1948, some physical abnormalities were noted.

Two adult male crappie taken in May, 1948, were found to have fins missing. One specimen (215 mm. standard length) lacked both pelvic fins and the right pectoral fin. The other specimen (265 mm.) had only one pelvic fin. In both there was no evidence, such as scar tissue, to indicate that these structures had been lost recently. The scales were perfectly formed over the areas where these fins normally would have attached. Such losses apparently had not hindered the development of the fish, as attested by the size and also by large masses of fat in the body cavity of each.

An adult male crappie (289 mm.), which had a tumor-like protuberance on its side at the base of the spinous rays of the anal fin, was brought to me in April, 1948. The swelling was approximately the size and shape of one-half of a large walnut shell. The area was covered with a comparatively normal arrangement of scales. Tissue in the growth was quite hard and compact. Inside the mass were several small rounded structures of cartilage-like hardness. As in the examples described above, the anomaly had apparently failed to hinder the growth and development of this individual.

In January, 1950, a female black bass, *Micropterus salmoides floridanus* (LeSueur), 530 mm. in standard length with a depth of 180 mm., was brought to the Department of Biology. This specimen, taken in Lake Rosa, Putnam County, Florida, had a large growth similar to that of the crappie previously described. The swelling was located on the right side immediately below the soft dorsal fin. The growth was removed and sent by Dr. J. C. Dickinson, of this department, to Dr. Herbert R. Mills, pathologist, of Tampa, Florida.

The tissue specimen, according to Dr. Mills, measured approximately 12 x 10 x 9.5 cm. and was covered over approximately half of its extent by skin. In addition to this tissue specimen there were three smaller portions of tissue, the largest of which measured approximately 7.5 x 6 x 2 cm. The entire specimen weighed approximately 470 grams. Gross sections showed in some areas a spongy structure, the cavities ranging from milary size to 3 cm. in diameter. Microscopical sections consisted of rather uniform connective tissue background which in some areas was quite vascular on account of rather large thin-walled channels. In some areas the connective tissue was found to be quite hyaline and suggestive of cartilage. Dr. Mills indicated that there was no evidence of malignancy and that the specimen was suggestive of fibroma.—GEORGE K. REID, JR., *Department of Biology, University of Florida, Gainesville, Florida*.

SIZE RECORDS FOR WHITE BASS, *LEPIBEMA CHRYSOPS* (RAFINESQUE), IN OKLAHOMA.—This species is a native of Oklahoma but has become more numerous since the creation of large artificial impoundments. Introductions of white bass into smaller reservoirs also have proved to be successful. A female white bass that weighed 1,985 grams was caught on March 15, 1950, from Horseshoe Lake (191 surface acres), Harrah, Oklahoma. Its total length was 470 mm. During the summer of 1949, a white bass that weighed 1,450 grams was taken from Lake Texoma. The total length of this individual was 465 mm. The size of the white bass from Horseshoe Lake is a record thus far in Oklahoma, and perhaps for the United States.—H. C. WARD, *Fisheries Division, Oklahoma Game and Fish Department, Oklahoma City 5, Oklahoma.*

A FURTHER NOTE ON PROTECTIVE BEHAVIOR IN FISHES IN REFERENCE TO BACKGROUND.—It has been shown by Breder (1947, COPEIA (4): 223-227) that the behavior of *Gambusia* over a self-matching background is strikingly different from their behavior over a contrasting background and that this difference persists until the fish are able to make appropriate adjustments in the chromatophores which render them less conspicuous.

Those who have had considerable experience working with living fishes probably have noticed that when fishes are released into a pond or aquarium by lowering the container gently into the water, they may show a considerable reluctance to leave it. While there are probably a variety of influences involved in this item of behavior, it can be nicely shown that one of these influences has significant bearing on data presented in the previously mentioned study of the behavior of *Gambusia*.

In connection with other experiments, large numbers of *Cyprinodon baconi* Breder were handled at the Lerner Marine Laboratory during February and March, 1950. They were retained for the most part in outdoor concrete tanks which had become dark colored because of a heavy growth of brown algae. White enameled pails were used for transporting the fish from the collecting grounds or for transferring the fish from one tank to another.

Repeated experiments showed that when *Cyprinodon* were transferred from the white pail where they had assumed their lightest color phase into a wooden tank with black painted sides and bottom, they quickly assumed their dark coloration. The dark banded pattern appeared in 15 seconds, and at the end of 50 seconds the fish were nearly indistinguishable from the bottom of the tank. In other words, the pattern appeared promptly while the diffuse darkening of the dorsal and lateral surfaces which served to obliterate the distinct pattern appeared more slowly. The fish then slowly and steadily darkened for several minutes more. A half hour sojourn in the white enameled pail was sufficient to bring about the reverse coloration, causing the fish to concentrate their melanin and bring about their lightest phase. In this species the light phase is an opaque white rather than silvery or transparent.

When such a pail full of fish was gently lowered into the dark concrete tank and turned to a horizontal position, the fish would swim to its edge and refuse to swim out at once. Finally, one fish would dart over the edge and then most if not all the rest would dart out after it. As soon as they were over the dark background and extremely conspicuous, they would dash about with erratic swimming motions, sometimes huddled against the sides of the tank or burying themselves in the algae. Within a few minutes, however, they darkened enough to become inconspicuous and could then be noted swimming about in their usual loose aggregational pattern. This is clearly the corresponding behavior to what Breder noted in *Gambusia* on a non-enforced passage from dark to light backgrounds, and would hardly be worth repeating as an identical note on another species except for the following facts. In certain cases the fishes, after rushing out over the dark background, would just as rapidly rush back into the pail before it could be lifted from the water, and then they would refuse to leave it at all. It was some little time before the significance of this was clearly apparent. Actually it was a little startling to have a group of fish rush with vigor into a waiting hand-held pail. The answer is as simple as it is pertinent to the interaction of locomotor behavior and chromatic adjustment to background. In certain of these concrete tanks various other fishes were placed for holding from time to time, such as small grunts (*Haemulon*) and snappers (*Lutjanus*). When no such possible predators were present, there was no return of the *Cyprinodon*

to the pail, but when one or more larger fish was present, the prompt return to the pail always occurred. This reaction was not prompted by any aggressive behavior on the part of the larger fish because when an object such as the white pail was introduced into the tank, the reaction of such a fish was one of hiding in a corner. Consequently, it would seem necessary to infer that the reaction of the *Cyprinodon* was determined by way of its own visual image of a larger fish resting quietly and inconspicuously in a corner.

To further substantiate these observations, the following experiment was undertaken. A small, flat, white-enameled tray was placed in each of two identical concrete tanks. One contained no fish and the other a few small snappers. Light colored *Cyprinodon* from a white pail were released in each. In the one with no other fish present, they settled over the tray and moved cautiously out from it until a passing shadow or similar disturbance caused them to return and huddle over it. The presence of the white tray retarded their darkening to some extent, but after several hours they gave it no further attention. In the tank containing snappers however, the reaction was different in that they promptly left the white tray after finding it, and buried themselves under the algae. Thus, a non-obliterate fish not only behaves differently from one which is inconspicuous, but there are several possible reactions which are evidently invoked appropriate to the kind of stimulation given by a specific combination of circumstances.

In the light of these observations, certain behavior of fishes in the open sea becomes more understandable. For example, small groups of *Mugil trichodon* Poey, of half a dozen or less individuals, may be seen frequently from the laboratory dock as they browse along over clear sandy bottoms or over dark beds of *Thalassia*. It was noted that some groups of these fish kept mostly to the light sandy areas while others just as persistently kept to the dark *Thalassia* beds. With sufficient observation, several cases were seen where such a group changed from one to the other. There was a hesitation to move over the "line" and when once over, there was a marked change in the locomotor pattern, the fish moving faster and again swimming erratically. This behavior persisted until there was a notable darkening of the fish, at which time the swimming returned to an easy smooth pattern.

It would thus appear that there is a closely integrated relationship between background, chromatophore condition and general behavior, in fishes which tend to match their background. The less understood fishes which do not at all match their backgrounds, as discussed by Breder (1949, *Bull. Amer. Mus. Nat. Hist.*, 94 (2): 83-106), await study in this regard.

Sumner (1934, *Proc. Nat. Acad. Sci.*, 20: 559-564) showed that *Gambusia* not matching their backgrounds were caught in greater numbers than were those which did match in the confinement of experimental tanks, while Brown and Thompson (1937, *COPEIA* (3): 172-181) showed that given a choice of two backgrounds *Erycymba* would move over the nearest matching one. Breder (1947, *loc. cit.*) demonstrated that the swimming pattern of *Gambusia* changes when it passes to a non-matching background, and it is here indicated that the same is true for both *Cyprinodon* and *Mugil*. Further, it is herewith demonstrated that the behavior under such conditions is modified by the visible presence of possible predators. There would thus appear to be an interplay of behavior changes appropriate to a fairly kaleidoscopic ecological variation, for it is not believed that all the possible modifications are included in the above listing.

Thus it is evident that chromatophore reaction, which is much slower than the locomotor reactions, is but one in a medley of possibilities of protective behavior which fishes employ in a pattern evidently appropriate to a given situation. A study of the neural mechanisms mediating this interplay should be well worth undertaking.

Since it is physiologically possible for certain fishes to change their coloration with extreme rapidity, the question might be raised as to why these background matching forms are evidently only able to do it slowly. Fishes which have prompt control over their chromatophores such as *Upeneus*, *Lachnolaimus*, and *Epinephelus* appear to use these prompt responses principally in reference to social behavior involving their own or other species. Here the need for a quick response is evident. Thus if a change of color or pattern is to be regarded as some social signal, it must be promptly displayed if it is to be effective. It is conceivable that in the background-matching types such speed is not necessary, especially in view of the various other behavioral activities discussed.—C. M. BREDER, JR. and PRISCILLA RASQUIN, *The American Museum of Natural History, New York 24, New York.*

THE POSITIONAL PATTERN OF THE COPEPOD PARASITE *SPHYRION LUMPI* ON THE ROSEFISH, *SEBASTES MARINUS*, AND ITS RELATIONSHIP TO THE BEHAVIOR OF THE FISH.—A most interesting association of host and parasite is found between the rosefish, *Sebastes marinus* (Linnaeus), and the copepod parasite *Sphyrion lumpi* (Krøyer). The latter, while recorded only rarely on several other species of fishes in Danish, British and American waters, is found abundantly on rosefish inhabiting waters of the Gulf of Maine. Little is known about the life history of *Sphyrion lumpi*. Krøyer (1863, Naturh. Tidsskr. Ser. 3, 2: 399-402) showed drawings of a larval form removed from the egg capsule which Wilson (1919, Proc. U.S. Nat. Mus., 55: 549-604) believed to be a free-swimming copepodid stage. Wilson further reported the male copepod to be 2 mm. long, 1 mm. wide and 5 mm. at its greatest thickness. No males were found by the writer, although parasites on thousands of rosefish were examined.

The form commonly found on the rosefish, and the one to be discussed further here, is the female. In the female *Sphyrion lumpi* the cephalothorax and a part of the neck are firmly embedded in the fish's flesh while the remainder of the neck and trunk are external (Fig. 1). Some idea of the size of the female is indicated by the measurements given by Nigrelli and Firth (1939, Zoologica, 24 (1): 1-10) of the trunks of 20 specimens

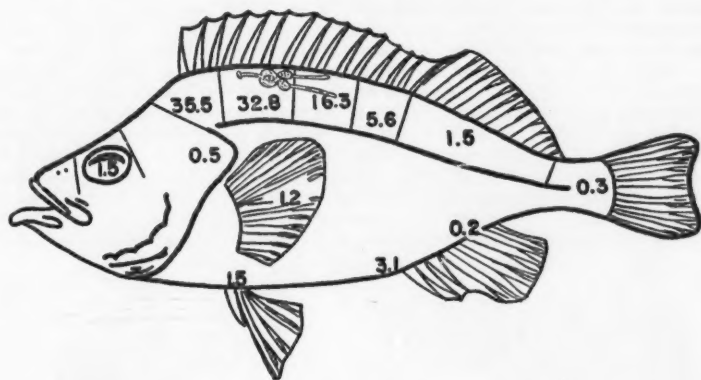


Fig. 1. Outline of the rosefish showing percentage distribution of attachment sites by the copepod parasite *Sphyrion lumpi*.

which ranged from 9 to 12.5 mm. in length, 10 to 15 mm. in width, and 3 to 8 mm. in thickness.

On the basis of museum material, which showed a concentration of copepods near the dorsal surface of the body of the fish, Wilson concluded that the parasite seeks to reach the dorsal aorta to assure itself of a copious supply of the host's blood as food. Nigrelli and Firth agreed that the blood of the host is the copepod's source of food. However, although they found that the copepod is present mostly in the region between the lateral line and the base of the dorsal fin, the area offering the easiest access to the dorsal aorta, they also report that "the parasite very seldom reaches a large (blood) vessel, and in no cases did they reach as far as the dorsal aorta." Their studies showed that mechanical and chemical stimulation of the host's tissue caused an inflammatory reaction which resulted in marked dilation of the adjacent blood vessels and a pouring out of their contents into the surrounding tissue. The overflowing blood elements are considered the source of nutriment for the parasite.

Nigrelli and Firth's findings would indicate that the concentration of copepods in the region between the lateral line and the base of the dorsal fin is due to something other than ready accessibility to the blood supply of the dorsal aorta. To study the matter fur-

ther the position of the copepod on the body of the rosefish was recorded, during the period from November, 1942 through October, 1943. A total of 736 copepods were examined. The results are summarized in Figure 1. The heaviest infection was found in the region between the base of the dorsal spines and the lateral line, accounting for 90.2 percent of all the copepods examined. Of the 90.2 percent, 35.5 percent was contained in the area between the nape and the third dorsal spine, 32.8 percent between the fourth and seventh dorsal spines, 16.3 percent between the eighth and eleventh dorsal spines, and 5.6 percent between the twelfth and last dorsal spines. The majority of the parasites in the region were closer to the base of the dorsal spines than to the lateral line. Continuing posteriorly, only 1.5 percent of the copepods examined were found at the base of the dorsal rays, and 0.3 percent on the caudal peduncle. The remaining 8 percent of the copepods were found near the bases of the anal, pelvic and pectoral fins, in the anal opening, on the head, and on the eye.

In the writer's opinion the positional pattern of *Sphyrion lumpi* on the rosefish can be explained by the behavior pattern of fish when attacked by external parasites. Other species of fish infected with external parasites have been observed, both in aquaria and in the field, to dart rapidly toward the bottom or toward a solid object and upon reaching it to roll over and scrape their sides. The roll is not complete and the dorsal margin of the fish, particularly in the humped anterior region, is little affected by the scraping action. Thus parasites attaching themselves at the "hump" are relatively undisturbed compared with those on other regions of the body. The scraping action would also be less effective any place on the body protected by folds of flesh or by protruding fins.

Taking the above data and observations into account, my explanation for the positional pattern of copepod infection of the rosefish is as follows: The free swimming larvae of *Sphyrion lumpi* attack indiscriminately all external parts of the body of the rosefish. The fish, by its rolling movement against the bottom or a solid object scrapes the larvae from most of the body. However, the dorsal hump is comparatively little disturbed by this action and therefore shows a high degree of parasite infection. Other parts of the body which are protected from the cleansing action by folds of skin, such as the eye and anal opening, or by fins, are rather persistent sites of infection.—ALFRED PERLMUTTER, State of New York Conservation Department, 65 W. Sunrise Highway, Freeport, L. I., N. Y.

NORTHERN RECORD FOR THE LITTLE TUNA, *EUTHYNNUS ALLETTERATUS*.—A new northern record for the occurrence of little tuna (little tunny, false albacore), *Euthynnus alletteratus* (Rafinesque), is believed to be registered with the capture of 28 of these fish, weighing a total of 390 pounds, on September 11, 1949, in Cape Cod Bay, Massachusetts. These fish were taken in a trap operated by Mr. B. Harlow Morrow near Sandwich, Massachusetts.

Previous to this capture there was no record of the little tuna north of the Cape Cod Peninsula, which apparently acted as a barrier to this fish, as well as to many other southern species. Bigelow and Welsh (1925, Bull. U. S. Bur. Fish., 40 (1): 211) did not record the little tuna and referred to the species only as "... a fish to be expected, though not yet actually recorded, in the Gulf of Maine." Breder (1948, Field Book of Marine Fishes of the Atlantic Coast from Labrador to Texas: 125) listed its range as "Cosmopolitan in warm seas occasionally north to Cape Cod..." LaMonte (1946, North American Game Fishes: 25) gave the range as "North to Cape Cod, Massachusetts; rather common off New York in summer and fall." Fraser-Brunner (1949, Ann. and Mag. Nat. Hist., Ser. 12, 2: 626-27) has recognized two subspecies: *E. a. alletteratus* (Rafinesque) from the North Atlantic and the Mediterranean and *E. a. aurolitoralis* Fraser-Brunner from the Gold Coast, West Africa.—HOWARD A. SCHUCK, U. S. Fish and Wildlife Service, Woods Hole, Massachusetts.

OVO-TESTES IN THE PERCID FISH *BOLEOSOMA N. NIGRUM* (RAFINESQUE).¹—Hermaphroditism has been recorded in many genera of bony fishes (Turner, 1946, Chicago Acad. Sci. Nat. Hist. Misc., 1: 1-2). Included are members of the perch family, Percidae, in which there are three subfamilies: the Luciopercinae or pikeperches; the Percinae or perches proper, including the familiar yellow perch; and the Etheostomatinae or darters, which alone of the three subgroups are confined to continental North America. Hermaphroditism has been described in the first two subfamilies. Dence (1938, COPEIA (2): 95) reported it in the yellow pikeperch or walleye (*Stizostedion vitreum*) and Turner (1931, Science, 74: 370) in the yellow perch (*Perca flavescens*). We add a record for the Etheostomatinae based on a specimen of the Johnny darter, *Boleosoma nigrum nigrum* (Rafinesque). This abnormal individual was found incidental to our experiments on the effects of light and temperature on the maturation of the gonads in this fish. The hermaphroditic Johnny darter was seined in Washtenaw Co., Michigan, in November, 1946, along with 140 other specimens of the same species. All of these individuals were maintained in experimental aquaria for some four months.

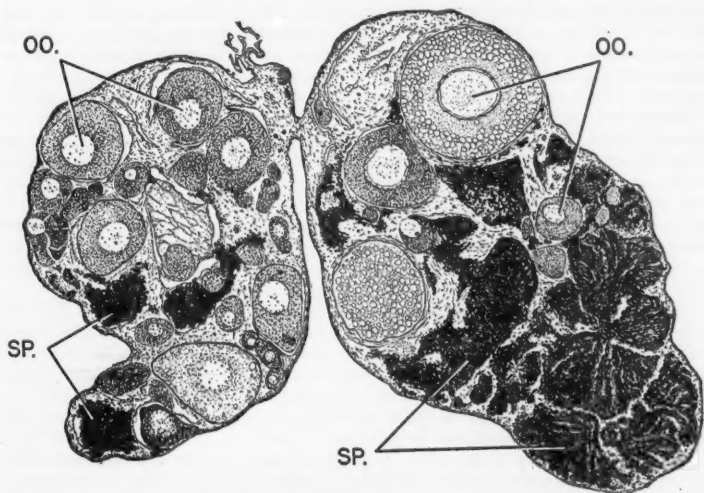


Fig. 1. Cross-sections of gonads of hermaphroditic Johnny darter, *Boleosoma n. nigrum*, showing oocytes (OO) and darkly stained masses of spermatozoa (SP). Magnification: approximately 80 diameters. Camera-lucida drawing by Quick Carlson.

The experimental conditions to which they were subjected could in no way be construed as the cause of producing an ovo-testis; the hermaphrodite was apparently a natural one. All of the others examined were normal. At the conclusion of the experiment in February, 1947, the fish were sacrificed. Their gonads were carefully removed and fixed in Bouin's. All of the gonads were then serially cross-sectioned.

Normal gonads in a male of 48 mm. standard length had an extreme length of 6.4 mm. and a greatest diameter of 1.4 mm. The lobules were filled with mature spermatozoa, which seemed to show some degree of polarity, their heads being directed mostly towards the periphery of the lobules. Along the margins of the testes were clusters of spermatogonia, spermatocytes, and spermatids. In the center of each such a cluster, mature spermatozoa were frequently to be seen. In general, the connective tissue, which separated the lobules, was not prominent. The lobules drain their products into the short paired sperm ducts. In most of the males examined, mature spermatozoa in varying quantities were found in

¹ Contribution from the Department of Zoology, Department of Fisheries, and Institute of Human Biology, University of Michigan.

the sperm ducts. This, however, is not unusual, because sperm may be expressed from Johnny darter males throughout the year, even though the spawning season normally occurs only from May through June.

In an apparently normal female Johnny darter, of 43 mm. standard length, the mature ovary had an extreme length of 4.4 mm. and a greatest diameter of 1.8 mm. Many mature oocytes were present, as seen by the high degree of vacuolization of their peripheral cytoplasm. The follicular membrane consisted of two rows of flattened cells. Less mature oocytes were also present in abundance. In the ripe condition, a nuclear membrane would be present in each egg as well as an immense deposit of yolk in the vacuoles. The short oviduct was, in contrast to the sperm ducts, devoid of any oocytes.

The ovo-testes (Fig. 1) came from a fish with a standard length of 45 mm. These gonads had an extreme length of 3.5 mm. and a maximum diameter of 1 mm. This fish, then, had about the same body length as the two fish just described, but the gonads were little more than one-half the size of normal ones in a male. Routinely, this fish was recorded as a male because of the presence of the lobate genital papillae externally visible, and the thin, white, strap-like gonads disclosed on dissection. On microscopic examination, however, each gonad was found to be testicular in its anterior quarter, ovarian and testicular in the middle, and testicular again in the posterior quarter. In the mid-portion, oocytes occurred in various stages of growth, interspersed with lobules of mature spermatozoa. There was much more connective tissue present in this area than usually seen in a comparable area in either the normal male or normal female Johnny darter. This connective tissue in no way divided testicular from ovarian parts of the gonads. There were apparently fewer germ cells present per unit of volume, but hermaphroditic gonads are seldom full-sized and correspondingly this abnormality in size and number of sex products was not unexpected. The accessory ducts were paired and structurally similar to one another, but they were not identical with normal sperm or egg ducts. At about the level of coalescence of the lobules and the ducts, an oocyte of about 50 microns in diameter occurred; also present at this level was a small cluster of mature spermatozoa. The oocyte was not a ripe or mature one, but rather, one in a stage of apparent resorption or degeneration, as noted by the irregularly atrophic, yolkless cytoplasm.

The ovo-testes of the Johnny darter somewhat resemble those described for the pikeperch (Dence, *op. cit.*) since both the anterior and posterior parts of the gonads were testicular. The mid-part, however, was entirely ovarian in the pikeperch. In the yellow perch (Turner, *op. cit.*), one gonad was primarily ovarian, the other, testicular. Caudal fusion of these two elements created a composite ovo-testis.

There can be no doubt that we had a functional male, since at least half of each gonad was testicular, mature spermatozoa were present in the ducts, and male "genitalia" were in evidence. The presence of an oocyte, as far down a duct as the one described, might indicate that the fish could produce eggs and shed them singly, depending on the locus of their development.—KARL F. LAGLER and MARY B. CHIN, *Departments of Zoology and of Fisheries, University of Michigan, Ann Arbor, Michigan.*

A RECORD OF THE COWNOSE RAY IN CHESAPEAKE BAY.—On August 24, 1950, a specimen of the cownose ray, *Rhinoptera quadriloba* (LeSueur), was harpooned by the author at Solomons, Maryland, 90 miles from the mouth of Chesapeake Bay. The only previous record of this species in the bay is from the extreme mouth (Hildebrand and Schroeder, 1928, Bull. U. S. Bur. Fish., 43 (1927): 71) although natives assert that this ray is often caught at Solomons. The salinity at Solomons was about twelve parts per thousand in August. The ray was seen swimming in water about 6 feet deep at the edge of a heavy growth of eel grass, with about a dozen other rays, presumably of the same species. The stomach contained what appeared to be molluscs. The body, exclusive of the tail, was 33 inches wide and 22 inches long, and the tail was 31 inches long. The specimen weighed 30 pounds. The author is indebted to Mr. Romeo Mansueti, of the Chesapeake Biological Laboratory, who aided in capture and preservation of the specimen, and to Dr. John Tee-Van and Dr. Henry B. Bigelow, of the Editorial Board of *Fishes of the Western North Atlantic*, who confirmed the originality of this report.—WILLIAM H. BAYLIFF, 745 Ranier Hall, University of Washington, Seattle 5, Washington.

FOOD HABITS OF THE SERGEANTFISH, *RACHYCENTRON CANADUS*.—In connection with my study of the utilization of menhaden on the Texas coast (Knapp, 1950, Trans. Amer. Fish. Soc., 79 (1949): 142), I reported the percentage frequency of occurrence of food organisms of 27 *Rachycentron canadus* (Linnaeus) as follows (22 stomachs analyzed): crabs 50.0, shrimp 50.0, squid 13.7, menhaden 0.0, other fish 95.5, and other invertebrates 59.1. Subsequently two additional fish were collected from the same area, making a total of 29 specimens taken between June and September 1948, near Port Aransas on the Texas coast.

No detailed or recent studies of the food habits of the sergeantfish, or cabio, in our waters have been published. Goode (1884, The Fisheries and Fishery Industries of the U. S., Sect. I: 444) found one on the New York market which contained 20 spotted crabs and several young flounders. He also quoted Holbrook (no reference) as saying "It is exceedingly voracious and destroys many smaller fish, which make its ordinary food, though it does not reject crustaceous animals." This latter statement is repeated by Goode (1903, American Fishes: 145). Sumner, Osburn and Cole (1911, Bull. U. S. Bur. Fish., 31 (2): 754) quoted Linton (1899, Bull. U. S. Bur. Fish., 19: 452) as saying that the food of the cabio consists of "fish (squeteague, etc.)." On checking Linton's work it was found that only one fish was examined by him and this was only after it had been held in a laboratory tank for one and a half months! Hildebrand and Schroeder (1927, Bull. U. S. Bur. Fish., 43 (1): 235) wrote "This fish is carnivorous, feeding on fish and crustaceans." Finally, LaMonte (1946, North American Game Fishes: 44) said "Food: crabs, squids, shrimps, smaller fishes, especially bottom fishes."

The scarcity of factual data on the food habits of this fish prompts me to treat the Port Aransas specimens in more detail. Of the 29 fish taken, 24 to 83 percent contained food; only these are considered in the accompanying table.

TABLE I

FOOD OF 24 CABIO, TAKEN NEAR PORT ARANSAS, TEXAS, JUNE TO SEPTEMBER, 1948

Food item	Scientific name	Number	Average size, inches	Percentage of occurrence
Crabs	<i>Callinectes danae</i>	39	1.75	42
Shrimps	Penaeidae	15	"bull"	46
Squid	<i>Loligo</i> sp.	9	?	17
Sea lice	<i>Squilla</i> sp.	50	4.5	58
Sea squirts	?	2	?	8
Shark	<i>Carcharhinus</i> (?) sp.	1	5*	4
Sea catfish	<i>Galeichthys felis</i>	1	9*	4
Eels	?	43	10*	50
Spanish mackerel	<i>Scomberomorus maculatus</i>	1	7*	4
Squeteague	<i>Cynoscion nothus</i> (?)	1	?	4
Croaker	<i>Micropogon undulatus</i>	1	?	4
Grouper	?	1	?	4
Unidentified fish	?	3	?	8

* Total length

A comparison of the food habits of *R. canadus*, as demonstrated herewith, with those of 10,016 fish of 34 species caught off the Texas coast (Knapp, *op. cit.*: 140), shows that 83 percent of the cabio had food in their stomachs whereas only 59 percent of the larger group of fishes contained food. This supports the concept that they (cabio) are voracious, a characteristic well known to sport fishermen who frequently hook two or three at a time from a single boat. The wide range of food items indicates that they are carnivorous in the true sense. The high incidence of *Squilla* and eels in their diet may indicate that they feed to a large extent near the bottom, but the presence of spanish mackerel, squeteague and other pelagic fish reveals that they also feed near the surface. The high incidence of eels and *Squilla* is particularly noteworthy since none of the other 10,016 fish studied contained eels and very few contained *Squilla*. This probably indicates a selectivity in the food habits of the cabio, but more information on the habits of eels and *Squilla* is needed before this can be determined. Listing the food items in terms of importance is not possible from the data collected. However, the percentage frequency of occurrence, coupled with the average

sizes, indicates that *Squilla*, eels, shrimps and crabs are staple items in the cabio's diet, whereas all other organisms (with the possible exception of squid) are incidental. One of the common names of the cabio is "crabeater," but since crabs occupy only fourth place in the food eaten, the name is hardly appropriate. However, crustacea, or at least invertebrates, probably constitute the majority of their food since 115 invertebrates, as compared with 52 vertebrates, were found in the 24 stomachs.—FRANK T. KNAPP, *Department of Wildlife Management, Texas Agricultural and Mechanical College, College Station, Texas.*

OCCURRENCE OF THE PADDLEFISH IN EASTERN KENTUCKY.—Welter (1938, *COPEIA* (2): 65-68) listed 70 species and subspecies of fishes known to occur in the Licking River system of eastern Kentucky. He failed to find *Polyodon spathula* (Walbaum), and there appears to be no published record for this species in that river system.

In July, 1950, I obtained a frozen paddlefish (696 mm. total length) from Mr. James Reynolds, Morehead, Kentucky. Mr. Reynolds caught the fish in August, 1949, from the East Fork of Triplett Creek, about five miles below Morehead, Rowan County. The stomach of the specimen contained, by volume, 85 percent water fleas (Cladocera), 10 percent small coleopterans, and five percent miscellaneous vegetable debris.

Fishermen relate that *Polyodon* (locally called "spoonbill cat") is sometimes caught in Lewis Pond, a small oxbow lake of Licking River a few miles above Farmers, Rowan County, as well as from the river itself. I have often heard my father refer to the taking of three large "spoon-bills," the largest weighing over forty pounds, from the North Fork of Licking River near Paragon, Rowan County, in the late 1880's.

The existence of a specimen (now in the zoological collections of the University of Kentucky) from the Licking drainage lends credence to numerous other verbal reports of the occurrence of *Polyodon* in the Licking River system.—ROGER W. BARBOUR, *Department of Zoology, University of Kentucky, Lexington, Kentucky.*

OCCURRENCE OF THE AGONID FISH *BOTHRAGONUS SWANI* IN CALIFORNIA.¹—Steindachner (1876, *Sitzungsber. k. Akad. Wiss. Wien*, 74: 192, pl. 4) described a new agonid fish, *Hypsogonus swani*,² from a single specimen collected in Puget Sound at Port Townsend, Washington. A new genus, *Bothragonus*, was erected for its reception by Gill (1882, in Jordan and Gilbert, *Bull. U. S. Nat. Mus.*, 16: 728). Subsequently *Bothragonus swani* has been reported from San Juan Island, Washington, and vicinity (Kincaid, 1919, *Puget Sound Fishes*: 35, fig. 81; Schultz, 1930, *COPEIA* (4): 139); from Cape Johnson (Hubbs, 1928, *Jour. Pan-Pacific Res. Inst.*, 3 (3): 14) and La Push (Hubbs, 1942, *Jour. Fish. Res. Bd. Canada*, 6 (1): 32, fig. 2C), both records based on one specimen from the outer coast of Washington; and from a few localities around Vancouver Island north to Queen Charlotte Strait, British Columbia (Bean and Weed, 1920, *Trans. Roy. Soc. Canada*, 13 (5): 78; Clemens and Wilby, 1946, *Bull. Fish. Res. Bd. Canada*, 68: 288, fig. 210).

This species is now added to the known California fish fauna on the basis of a single specimen from Shell Beach, Sonoma Coast State Park, Sonoma County, approximately 38° 23' N. and 123° 05' W. The fish was collected by Col. Lee O. Miles on November 19, 1949, in a tidepool, at -1.4 tide. It bears catalogue number 1126 in the Allan Hancock Foundation fish collections.

Measurements of the specimen are as follows: standard length 71 mm.; head 22.5 mm.; depth from posterolateral border of occipital pit to base of ventrals 22.5 mm.; snout 4.2 mm.; gape 5.4 mm.; orbit 3.7 mm.; interorbital space 5.8 mm. The fin ray counts are D. IV, 4; A. 4, whereas those of the type specimen were D. III, 5; A. 5. Otherwise it does not differ appreciably from the description given by Steindachner and repeated (English translation) by Jordan and Evermann in "Fishes of North and Middle America" (1898, *Bull. U. S. Nat. Mus.*, 47 (2): 2086).

With this California record the known range of the species is extended about 650 miles southward from La Push, Washington.—JANET HAIG, *Allan Hancock Foundation, University of Southern California, Los Angeles 7, California.*

¹ Contribution from the Allan Hancock Foundation, No. 61.

² Not to be written *H. swanii*, as done originally, according to a revision in the International Rules (1950, *Bull. Zool. Nomen.*, 4: 200).

REVIEWS AND COMMENTS

CLAVES PARA LA DETERMINACION DE ESPECIES EN LOS PECES DE LAS AGUAS CONTINENTALES MEXICANAS. By José Alvarez. Secretaria de Marina, Dirección General de Pesca e Industrias Conexas, México, 1950: 1-144, figs. 1-16.—Not since the publication of Meek's (1904) treatise on "The Fresh-water Fishes of Mexico North of the Isthmus of Tehuantepec" or Regan's (1906-08) account of the fishes in "Biología Centrali-Americana," has there been a comprehensive source to which the student of Mexican freshwater fishes could turn for identifications. Although the area of this Republic is only one-fourth that of the United States, México has a rich freshwater fauna which, when fully known, will probably exceed 350 species. This is approximately one-half of the number of species of freshwater fishes known from the United States.

For one who had studied Mexican fishes for many years, the preparation of workable keys to such a vast and varied fish fauna would prove to be a herculean task. Señor Alvarez, limited in first-hand experience with the general Mexican fauna, has been forced to rely heavily upon the literature in preparing his keys. The bulk of this literature is from 15 to nearly 50 years old, and the varied practices of the contributing authors in making counts and measurements has rendered the preparation of accurate and usable keys even harder. Any compilation is bound to be fraught by such difficulties and, although Dr. Alvarez expended a great deal of time handling the many publications covering Mexican ichthyology, the keys do not always measure up to the high standards set by their author. This resulted in part because the literature did not receive the critical reappraisal which is so vital to our understanding of the complicated ramifications of such groups as the species of *Notropis*, the catfishes, the cyprinodonts, and the cichlids. Careful study of the many old type specimens also will be required before the ichthyology of México can be set in order.

The keys are written for use by scientist and layman alike and are prefaced by a section that includes detailed explanations, with accompanying figures, of how measurements and counts are made. Only species that unquestionably occur in México are treated, including those that inhabit waters above tidal influence. There is an index to the families but, unfortunately, no index to scientific names is included. The layman, as well as the beginning student, will experience difficulty in attempting to run down species that do not key out in the first 50 pages of the text. This inconvenience could have been lessened by having a key to the families, followed by separate keys to the species within each family.

The nomenclature is mostly up-to-date and the descriptions, in large part, appear to be reasonably accurate. I have noted, however, some important systematic errors that are discussed below (with page references in parentheses). Practically all of these changes have been treated in the systematic literature of the last two decades. There are so many typographical errors (such as *Ictaluros* for *Ictalurus*, *Ribulus* for *Rivulus*, *Eleotris* *pinctus* for *E. picta*, *Sisyidium* for *Sicydium*, etc.) that it seems evident that proof was not read by the author.

Salmo irideus and *S. nelsoni* (25) are the same species, *S. gairdneri*,¹ and are scarcely distinguishable subspecies (Hubbs, 1946, Calif. Fish and Game, 32 (2): 84-85). The genera *Ameiurus* and *Ictalurus*, as currently recognized, are badly confused in the key (32-34), which follows the classification used by Meek. Seven nominal species (*A. meeki*, *A. pricei*, *A. lupus*, *A. australis*, *A. ochoterenai*, *A. mexicanus*, and *A. dugèsi*) should be transferred to *Ictalurus*; how many of these are specifically distinct from *I. lacustris* remains to be determined. The use of the posterior extension of the supraoccipital process as a character for generic distinction between *Ameiurus* and *Ictalurus* is untenable because of the variable development of this process. *I. punctatus* is conspecific with *I. lacustris*. The stickleback of Baja California (38) is currently designated as *Gasterosteus aculeatus microcephalus* Girard (see de Buen, 1947, Anales Inst. Biol. México, 18 (1): 275). In perpetuation of an old error

¹The International Commission has ruled (1950, Bull. Zool. Nomen., 4: 200-206) that a modern patronymic is to be formed by adding an -i to the complete name, where the trivial name is based upon the surname of a man. Hence the original spelling, *gairdnerii*, is abandoned. This ruling cancels Opinion 8.

by Regan, *Dorosoma* is said to have a single supplemental maxillary and *Signalosa* two supplemental maxillaries (38); both genera have two supplemental maxillaries, as pointed out by Hubbs and Miller (1941, COPEIA (4): 233). *Ictiobus meridionalis* Günther is a good species and should be added to the key (42). *Catostomus conchos* Meek and *C. sonorensis* Meek, properly recognized as valid species by de Buen (*loc. cit.*: 264), are left out of the key (44). *Apocope oscula* (45) has long been placed in the genus *Rhinichthys* and should now be called *R. nubilus*, as that name has line priority over *R. osculus* (1950, Bull. Zool. Nomen., 4: 328). The dental formula of *Rhinichthys* (of which *Apocope* is a subgenus) is 2, 4-4, 2 or 1, 4-4, 1, the anal rays are almost invariably 7 (8 is a rare variant), and the premaxillaries are non-protractile (the frenum is variably developed in *R. nubilus*). *Gila elegans* (50) is a subspecies of *Gila robusta* (Miller, 1946, Jour. Wash. Acad. Sci., 36 (12): 412-414) and *G. r. intermedia* (Girard) is inadvertently left out of the key. *Phenacobius scopifer* (51) is a synonym of *P. mirabilis* (Girard), as pointed out by de Buen (*loc. cit.*: 271). *Cyprinodon latifasciatus* (62) is a distinct species (not a subspecies of *C. bovinus*). *Cyprinodon eximius* Girard, from Chihuahua, should be added to the key. *Fundulus grandis* (65) is a distinct species (not a subspecies of *F. heteroclitus*). *Gambusia nobilis* (84) should be removed from the key, since this species is confined to the Pecos River drainage of New Mexico and western Texas (Hubbs, 1926, Misc. Publ. Mus. Zool., Univ. Mich., 16: 23); the Mexican records (by Meek and others) represent misidentifications. *G. patruelis* is currently regarded as a synonym of *G. affinis* (Baird and Girard). The atherinid of the Río Balsas (98) is retained as a distinct genus and species, *Melaniris balsanus* Meek, by the latest reviser (Schultz, 1948, Proc. U. S. Nat. Mus., 98: 30). *Achirus mazatlanus* (108) is said to have 70 scales in a longitudinal series; it actually has 54 to 61. *Achirus jonsecensis* has about 60 to 65 (not 85) longitudinal scale rows, 57 to 61 dorsal rays, and 42 to 45 (not 85) anal rays (Gilbert and Starks, 1904, Mem. Calif. Acad. Sci., 4: 201-202). *Achirus fasciatus* should be called *Trinectes maculatus fasciatus* (Hubbs, 1932, Proc. Biol. Soc. Wash., 45: 19-22). The genera *Philypnus* (132-133) and *Chonophorus* (134, 136) have long been called *Gobiomorus* and *Awaous*, respectively (see Hildebrand, 1938, Field Mus. Nat. Hist., Zool. Ser., 22 (4): 339, 356).

A few other, more or less original, observations designed to assist the student of Mexican freshwater fishes are added as a supplement to the foregoing corrections. *Anguilla bostoniensis* (22) should now be called *A. rostrata* (LeSueur) in consequence of the new ruling by the International Commission (*loc. cit.*: 328) that substitutes page and line priority for the "Rule of First Reviser." *Ictalurus pricei* (33) has 20 to 25 (not 19) anal rays—counts based on material from the Río Yaqui, Sonora, to the Río del Fuerte, Sinaloa. Critical study of the Mexican representatives of the genus *Rhamdia* (35-37) will probably reduce the number of species to 2 or 3, possibly 4. *Rhamdia godmani* and *R. petenensis*, for example, are only subspecies of *R. guatemalensis*. The status of *Couesius adustus* Woolman (45) is uncertain and will likely remain so until the 3 type specimens are carefully reexamined. *Notropis orca* (54) is a subspecies of *N. simus* (Cope). The cuatro-ojos (60) should be called *Anableps dowi* (see footnote 1). *Cyprinodon elegans* (61) is confined to Comanche Springs and Phantom Lake, Texas, and thus should be deleted from the key. *Cyprinodon bovinus* (62), known thus far only from Texas, also should be deleted since the only published records for México are based on other species. The status of *Fundulus vincius* and *F. extensus* (65) is very questionable; either neither species is valid (as held by Hubbs, 1931, Occ. Pap. Mus. Zool., Univ. Mich., 231: 2-3) or perhaps one may be recognizable. *Mollienesia* (92) should be spelled *Mollienesia* (Bailey and Miller, 1950, COPEIA (4): 318). *Etheostoma laterale* (128) is a goby.

It is hoped that in revising these keys Dr. Alvarez will base his data more on the examination of fresh specimens and less on the literature, which too often contains hidden pitfalls and conflicting data. A review of the revised keys by his colleagues would also prove profitable.—ROBERT RUSH MILLER, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

STUDIES HONORING TREVOR KINCAID. Edited by Melville H. Hatch. University of Washington Press, Seattle. 8vo., 140 pp., 13 pls. August 1, 1950. \$2.50.—This collection of studies by colleagues and former students honors Prof. Kincaid, the University of Washington's beloved grand old zoologist, who has recently retired from active teaching. Besides having had a great influence on the development of many

zoologists and fishery biologists who have been his students, Prof. Kincaid is himself well known in the fishery field for his work on oysters.

The book contains a biography of Prof. Kincaid, an account of Orson Bennett, another pioneer naturalist of the Northwest, and of the locally famous "Young Naturalists' Society," all by the editor. In addition, there are studies of the thyroid follicle (by Johnson), of a foraminiferan genus (by Frizzell), of echinoderm development (by Johnson and Johnson), of trematodes (by Bonham), and of Neotropical spiders (by Exline). Of special interest to COPEIA readers will be papers by Schultz on South American Characidae and by Martin on the blood volume of fishes. The latter is of considerable interest, breaking what is practically new ground in fish physiology.—GEORGE S. MYERS, *Stanford University, California*.

THE NATURE OF NATURAL HISTORY. By Marston Bates. Charles Scribner's Sons, N.Y., 1950: viii + 309. \$3.50.—Marston Bates has turned from his eight years of directorship of the jungle yellow fever laboratory in southern Colombia, at the Amazonian base of the main range of the Andes, to a wholly new field, the emerging science of human ecology. *The nature of natural history* is a kind of rapid review of the knowledge and insights gained in Dr. Bates' more strictly scientific career, presumably in the belief and hope that the biological approach to human problems may fruitfully link the social sciences to the supposedly "more scientific" natural sciences. The publishers designate the book as "A study in the approach of science to the living world of which we form a part." This is *ecology*, a term mainly rejected in the book in favor of "natural history."

Ecology is in fact a fairly old term for one of the major sub-sciences of biology including all of the older observational natural history. The new term seems to be more essential than Dr. Bates allows, for it connotes a turning away from the anthropomorphic and often emotional observations, accumulated since Aristotle under the heading of natural history, to a more critical and objective point of view of essentially the same material.

The review of the sciences on which Dr. Bates' natural history (and our ecology) is based runs rapidly and competently through fourteen chapters, covering the topics of nomenclature and classification; paleontology; reproduction, sex, heredity, and embryology; the environment in which organisms live; partnership, cooperation, and parasitism; behavior of individuals and of populations; biogeography; and adaptation and evolution. The purpose of this summary then emerges in the final chapters, which examine the relations of natural history to the human economy, the nature of its practitioners, and "Tactics, Strategy, and Goal."

It is evident that science does need to "take stock," to consolidate its gains and to synthesize its divergent special fields. Only then can one take a longer view and take thought about the old problems and the new ones that appear with the synthesis. Dr. Bates wishes, in fact, to break down the artificial barriers between science and philosophy. He does not make the point, as I should, that the pursuit of pure science is an expression of higher ("emergent") qualities of the human spirit, and that such pursuit requires no more "economic" justification than does the composition or the interpretation of music, and is as little amenable to explanation. He distinguishes somewhat more sharply than I should, and indeed than I have,¹ between the naturalist and the nature-lover. It is especially gratifying to find in his account of the method of science adequate appreciation of *observation* as well as of experimentation and critique.

The only discernible human goal is seen in *survival*, the survival of the individual and of our species, and presumably of the family and of more complex groups within the human species. This leads him to stress conservation. Finally, he hopes that scientific thought in general and ecological thought in particular may have a valid goal in the search for insights and understanding; this coincides with what I mean by pure science as an end and as a value-in-itself.

An excellent annotated reading list forms an appendix, by way of documentation, and as a happy alternative to footnotes or detailed references scattered through the text.—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago 5, Illinois*.

¹ What is a naturalist? A study in natural history. *Chicago Naturalist*, 6: 29-36, 51-63, 84-98; and *COPEIA*, 1946: 57-63.

SOME VERTEBRATE ANIMALS OF CEYLON. VOL. 1. By P. E. P. Deraniyagala. Nat. Mus. Ceylon Pictorial Series, Colombo, 1949: 119 pp., 96 pl. (1 col.). Boards—Rs. 3.50 or 7 shillings.—This book was published "to keep the public—both scientists and laymen—abreast of the information . . . about the fishes, reptiles, birds and mammals of Ceylon." With such an objective it is most unfortunate that economies of publication were placed ahead of the quality of the product. The list (pp. 117-9) of 60 titles published by this worker on the recent and extinct animals of Ceylon is sufficient to demonstrate his ability to deal with a work of this scope, but this ability has been sacrificed by the use of unsuitable methods of reproduction on equally unsuitable paper.

The preface is a much condensed (two page) introduction to such diverse subjects as zoogeography, paleontology, and the method of using a key. The main body of the work is divided systematically—each division consisting of an introductory section to the animal group (usually the class), an abbreviated "explanation of plates," and the plates themselves. The amount of information in the introductory section varies. In the division on "Fishes" characteristics are given by which some of the families may be distinguished, with plate references to examples of these families. The reptile section contains keys to the orders, to the suborders of the squamata, and to the species of turtles and crocodilians. In later sections of the text there are diagnoses of the families of lizards and snakes with keys (usually to genus only) to the Ceylon representatives of the former and a key to the "strongly poisonous" members of the latter. The bird division contains merely a characterization of the class and short diagnoses of the orders; the mammal division, in addition, has the description of two new subspecies—*Melursus ursinus valaha* for the Ceylon Sloth Bear, and *Panthera pardus kotiya* for the Ceylon Leopard. The latter is described on the basis of its "not throw[ing] out clouded or marbled color variants."

The loss of quality from the use of a cheap grade of paper may only be appreciated by direct comparison of the original plates with the present ones (compare Pl. 44 with Deraniyagala, 1932, Ceylon Jour. Sci., Sect. B, XVI (3): Pls. 62-4). The line drawings, such as those from Wall (Snakes of Ceylon, 1921, H. R. Cottle, Colombo), suffered least, while the half-tones are most affected—some of them being almost unrecognizable (Pl. 93 [b]). The single colored plate (Pl. 33) further emphasizes the lack of good quality reproduction. The use of old plate blocks from previous publications left little possibility for consistency in format. In Pl. 19, although the reproduction is unusually good, fishes (a), (b), and (d) face to the left, while fish (c) faces right. Erratic figure arrangement occurs throughout the work and is not only disturbing to the reader but can be confusing as well, especially in the figures of *Typhlops* (Pl. 51) where the ventral view is shown on the left in (a) and (c), but on the right in (b).

From a personal viewpoint it is felt that the space used in picturing features of limited interest, such as the numerous figures on reptilian embryology (Pl. 28, 29, 41 [b-f]), might better have been utilized in more complete explanations of the plates. A comprehensive survey of an island fauna such as this, produced in atlas form with a better quality of reproduction, should be a valuable addition to any biologist's library and it is hoped that future volumes of this series will not be so handicapped.—HERNDON G. DOWLING, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

GLI ANIMALI SUPERIORI NELLA LORO STRUTTURA E NELLA LORO VITA; AVVIAMENTO ALLO STUDIO DEI VERTEBRATI E DEGLI ALTRI COR-DATI. By Enrico Tortonese. Societa Editrice Internazionale, Torino, Italia, 1949: xvi + 464 pp., 300 text-figs., 6 colored plates.—Italy's most active systematic ichthyologist has just published this fine and useful text-book on the vertebrates, their classification and natural history. In contrast to so many texts, the treatment is distinctly modern, and demonstrates the author's wide knowledge and discriminating use of the recent world literature of the subject. The paper and typography are good, the many illustrations are adequate and the bibliography is full and well chosen. We congratulate the author on the publication of an excellent text, which will take an honored place among the relatively few modern works of its kind.—GEORGE S. MYERS, *Stanford University, California.*

LIST OF DANISH VERTEBRATES. By Anton Fr. Bruun, J. R. Pfaff, Bernt Løppenthin and Magnus Degerbøl. Dansk Videnskabs Forlag (Danish Science Press, Ltd.), Copenhagen, 1950: 1-180, 1 map. 10.50 Danish Kr. (= about \$1.50).—This attractively printed contribution presents a general survey of the 688 species comprising the Danish vertebrate fauna. About one-half of these are birds which, together with the mammals, take up 83 pages of the booklet.

The fishes are treated on pages 19-60 by Bruun and Pfaff. One hundred and eighty-three marine species (exclusive of anadromous forms) and 32 native freshwater species are listed. The nomenclature of the lampreys and sharks is the same as that used by Bigelow and Schroeder in the first volume of *Fishes of the Western North Atlantic*. Following the scientific name of each species is given the author, common name, local literature citations, and a statement of the seasonal status, general habitat, distribution and abundance.

The amphibians and reptiles, by J. R. Pfaff, are covered on pages 61-66. The depauperate representation of this group includes only 14 species of amphibians, with 3 salamanders and 11 frogs, and only 7 species of reptiles: 3 lizards, 3 snakes, and 1 turtle, *Dermochelys coriacea*, reported for the first time in 1949. The European pond turtle, *Emys orbicularis*, like the catfish, *Silurus glanis*, has become extinct within historic time, as has *Elaphe l. longissima* (last seen in 1863). Increasingly cooler temperatures are believed to have brought about the extinction of these southeastern species.

Zones of migration and dispersal routes are discussed for all the vertebrates in the Introduction. Of further interest to zoogeographers are lists, in the opening pages of the Introduction, of Glacial, Interglacial and Postglacial fossils (mammals, birds and fishes) together with comments on the significance of these finds in interpreting the paleoclimate and biogeography of Denmark. A helpful, folding map follows the complete index to common and scientific names.—ROBERT RUSH MILLER, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan*.

THE EASTERN BROOK TROUT. By Bob Elliot; W. W. Norton and Company, Inc., New York, 1950: 242, \$5.00.—This handsomely printed book with some nice kodachrome and black and white illustrations is devoted solely to the eastern brook trout, as the title implies.

Various methods of fishing for brook trout are depicted on the background of the writer's wide personal experience. Different types of tackle and the choice of artificial flies come in for considerable discussion.

Elliot's knowledge of biology is as weak as his knowledge of angling is extensive. Why outdoor writers think they must pretend to be ichthyologists is a mystery. True they consult and cite learned references but they understand not what they read and confuse the reader by incorrect interpretations. For example—"Head and depth 4.5 means the length of the body is four times length of head and five times its own depth."

Many will object to the rather blatant publicity given to Maine and its fishing. One gathers the impression that, although Canada has some brook trout and admittedly holds the world record, if one really wants to sample choice fishing he must come to New England! Also objectionable is the publicity for his fellow outdoor writers and for commercial tackle manufacturers. Much of the book reads like a testimonial or advertisement. Publishers are generally more discriminating.—ALBERT S. HAZZARD, *Institute for Fisheries Research, University Museums Annex, Ann Arbor, Michigan*.

HANDBOOK OF FRESHWATER FISHERY BIOLOGY. By Kenneth D. Carlander. Wm. C. Brown Company, Dubuque, Iowa, 1950, v + 281 pp., 2 figs., 5 charts, lithoprinted. \$4.50.—This is a fine example of one man sharing the fruits of his labors with others. Professor Carlander has spent years indexing and summarizing the literature on age and growth of freshwater fishes of the United States and Canada. The results are a series of compact tables of data and an extensive bibliography.

Mostly, anadromous fishes are not included. In addition to age and growth, subjects

treated to a limited extent are creel census, population density, annual yield, fecundity, and conversion tables. The tabular data on age and growth are arranged by age group, subdivided geographically, and include numbers of specimens, ranges and averages of lengths and weights. Particular attention is given to differentiation between standard, fork and total lengths, and to conversion factors between the three measurements. Tabular material is completely identified as to source, by the use of reference numbers matching the bibliography, a system which is especially convenient. There is an index to species.

As the author points out, his summaries should serve as a helpful quick reference to see what studies have been made on a particular species and approximately what the growth in different localities is. Anyone doing research on a particular species would, no doubt, refer to the original papers, but the present work will save investigators much time in searching the literature. The bibliography includes over 1100 titles many of which are from lesser-known journals and report series.—GERALD P. COOPER, *Institute for Fisheries Research, University Museums Annex, Ann Arbor, Michigan.*

SALT-WATER FISHING. A COMPLETE GUIDE TO SALT-WATER FISHES AND HOW TO CATCH THEM. By Robert A. Dahne. Henry Holt and Co., N. Y., 1950: 342 pp., illus., \$5.00.—Some day, someone will start early enough in life to thoroughly acquaint himself, or herself, with all kinds and types of saltwater angling. When that day arrives, and allowing that such a competent angler will prove to be just as competent in writing, a worthy and perfect book on saltwater fishing probably will be made available to the public. Many books on saltwater angling have been written. In all that I have read there are numerous mistakes that result because the author lacked knowledge on a type or kind of fishing for one or more species of game fishes. In most of these books, the author has perused other books and rewritten from them, thereby carrying on the mistakes made by the original authors. This has been so pronounced that several recent books on saltwater fishing have been written, not by one author, but by several authors collaborating to produce an authoritative volume.

The author of *Salt-water fishing* has had considerable experience in his chosen subject, but even his experience is limited whereas his subject is large. Judging from this basis, the book is a useful compendium of saltwater fishing knowledge. However, like many other books, *Salt-water fishing* contains errors that could only be remedied by authors who have had more and wider experience.

The more than 80 illustrations by Elena K. Mead are quite well done, but these, too, show that the illustrator has not seen specimens of all the fishes illustrated. In this connection, it may be truthfully said that there are not more than three books on freshwater or saltwater fishing that accurately picture the fishes so that they could be easily recognized by the angler.

Dahne's book will do. It is interestingly written, is authoritative on most details, and it is well worth reading. I would say that it surely deserves a place in the library of saltwater fishing enthusiasts, along with other books on saltwater fishing. The book is well arranged, informative, and the publishers have done a grand job of printing.—EARL ROMAN, *University of Miami, Coral Gables, Florida.*

WILDLIFE MANAGEMENT BULLETIN. Canada Department of Resources and Development, Wildlife Service, Ottawa, Ontario. Mimeographed, bound, issued periodically, Series 3 Number 1 dated May, 1950, and Series 3 Number 2 dated June, 1950.—The two numbers, cited here, contain reports on fisheries research projects, respectively, "Prince Albert National Park Creel Census Analysis Season 1948" and "Limnological Investigations of Fundy (New Brunswick) National Park, 1948," both by Victor E. F. Solman. A letter from Dr. Harrison F. Lewis, Chief of the Canadian Wildlife Service, states that this bulletin deals with fish and other aquatic matters, and is available (not in quantities) free-of-charge by addressing the Service. Series 1 of the Bulletin is reserved for papers on mammals, Series 2 for birds.

EDITORIAL NOTES AND NEWS

Cornell Graduate Studies

THE following research problems are now under way or were recently completed in the Department of Conservation, Cornell University: DR. ROYAL D. SUTTKUS has finished his doctoral investigation, "A taxonomic study of five cyprinid fishes related to *Notropis hypselopterus* of southeastern United States," and has accepted a position as Assistant Professor of Zoology at Tulane University. He will teach ichthyology, continue his studies on taxonomy and life histories of southern fishes, and build up the collection of fishes.

DR. HOWARD E. EVANS, with a major in the Anatomy Division of the Zoology Department, has finished his doctoral dissertation, "Structural modifications correlated with feeding habits in four species of cyprinid fishes" (*Rhinichthys cataractae*, *Notemigonus crysoleucas*, *Cyprinus carpio*, *Semotilus atromaculatus*). He is continuing his anatomical studies on fishes and reptiles, as well as on mammals, as Assistant Professor of Anatomy in the New York State College of Veterinary Medicine at Cornell.

DR. RALPH W. YERGER, who has done work in ichthyology (including field work on southeastern freshwater fishes) while majoring in mammalogy at Cornell, has accepted a position as Assistant Professor in the Department of Zoology at Florida State University, Tallahassee, and will teach a course in ichthyology.

ROBERT D. ROSS has nearly completed his doctoral dissertation on speciation in eastern populations of the cyprinid *Camptostoma anomalum* and is now employed by T.V.A., Oak Ridge, Tennessee, where he is working with a team studying the effects of radioactive wastes on fishes and other aquatic life.

RICHARD H. BACKUS spent his second summer along the Labrador Coast on the schooner "Blue Dolphin." His collections of fishes are at Cornell and are now being studied. Information regarding unreported fish collections from Labrador would be appreciated. BACKUS has made a start on a doctoral dissertation investigating the taxonomy of the satinfin minnows, *Notropis* (subgenus *Cyprinella*).

ROLAND L. WIGLEY is engaged in a doctoral study of the life history of the sea lamprey, *Petromyzon marinus*, and its effect on the fishery in Cayuga and Seneca lakes. This is a cooperative study supported by the U. S. Fish and Wildlife Service.

CHARLES R. ROBINS and RONALD W. CRAWFORD are also graduate students working on freshwater fishes.

Under the direction of DR. D. A. WEBSTER, studies on New York farm ponds are underway by SAUL SAILA, and the work on trout survival in Fall Creek, and lake trout and smallmouth bass studies in Cayuga Lake, are being pursued by ALBERT EIPPER and other graduate students.

The "Galathea" Around the World Expedition

ON October fifteenth, the Danish Deep-sea Expedition, 1950-52, left Copenhagen on what promises to be one of the most important oceanographic ventures of all time. The 265-foot twin-screw motor vessel "Friendship" has been completely refitted for the trip and renamed the "Galathea."

The director of the expedition is DR. ANTON BRUUN of the University of Copenhagen's Zoological Museum, while the commander of the ship is CAPTAIN SVEND GREVE of the Danish Navy. The responsibilities of the Expedition will be in capable and experienced hands, since both of these men participated in the circumnavigational cruise of the "Dana" in 1928-30, and DR. BRUUN was the leader of the "Atlantide" Expedition to the west coast of Africa in 1946-47. The ship will carry a scientific staff of eleven, four representatives of the press and film industries, and a crew of about 70. Only two of the scientists will remain aboard for the entire trip. A relay system has been worked out which will permit most of

the marine biologists of Denmark to join the ship for a period of a few months. As a splendid gesture of international cooperation, foreign scientists have been invited to participate in a similar way. The United States will be represented on segments of the cruise by DR. CLAUDE E. ZOBELL of the Scripps Institution of Oceanography and DR. ROLF L. BOLIN of the Hopkins Marine Station.

The primary purpose of the expedition is the biological exploration of the great depths, although oceanographic physiography, hydrography, and terrestrial magnetism will also be investigated. The ship carries the longest cable ever built, a tapered steel-wire rope 12,000 meters long. With this it is planned to operate large gear, such as commercial otter trawls, in the almost totally unexplored deeps.

After touching at Plymouth, Lisbon, and the Canary Islands, the "Galathea" is making its way south off the west coast of Africa and will be working off the Cape of Good Hope at Christmas time. A swing eastward will take her to Madagascar, Réunion and Mauritius before turning back to Mombassa on the east African coast; from there she heads, by way of the Seychelles Islands, Ceylon and Calcutta, for an extended period of work throughout the entire East Indies; a side trip will take her as far north as Yokohama. After almost completely circumnavigating Australia, the ship will arrive in Wellington, New Zealand, about January 1, 1952. A swing to Macquarie Island will take her to the fringes of the Antarctic and the southernmost point of the trip. Turning north again, the expedition will work back to Fiji and then eastward through the Pacific Islands to Valdivia, Chili. From this point the "Galathea" turns northward for the Panama Canal by way of San Juan Fernandez Island and the Galapagos. After passing through the Canal, some work will be done in the Puerto Rico Deep and the return to Copenhagen, after two years and almost 70,000 miles, will be made via the Azores and Plymouth.

It is planned that, if possible, the ship, or at least some of her equipment and collections, will be on display in the Danish capital during the meetings of the Fourteenth Zoological Congress. By that time new luster will have been added to an old name which was brought into prominence in the field of science more than a century ago, when the first Danish "Galathea" made her circumnavigation of the globe in 1845-47.

New Ichthyological Journal in Japan

PROFESSOR TOKIHARU ABE writes that a "Japanese Society of Ichthyologists" (Uo No Kai) was formed a few years ago by Japanese ichthyologists, anglers, artists, and others interested in fishes and fishing. A popular magazine, "Pisces" (Uo), was inaugurated and four issues have been published (to Nov. 24, 1950). Recently, a scientific journal, the "Japanese Journal of Ichthyology," was published, aided by the newly established "Japanese Society for the Promotion of Ichthyology" (Nihon Gyogaku Shinko Kai). This society is financed by a few commercial fishermen in the Central Wholesale Market of Tokyo. The journal is published bimonthly, each issue containing more than 64 pages, with 6 issues comprising a volume. It is offered in exchange for COPEIA (6 numbers for 4 numbers), but will be distributed gratis to Japanese ichthyologists abroad. The journal is largely in Japanese, with summaries in a European language.

Committee on Nomenclature

IN December, 1950, PRESIDENT MYERS appointed an A.S.I.H. Committee on Zoological Nomenclature, as follows: DR. W. I. FOLLETT, (Chairman) California Academy of Sciences, San Francisco; DR. C. M. BOGERT, American Museum of Natural History, N.Y.; DR. A. GROBMAN, University of Florida, Gainesville; DR. R. R. MILLER, University of Michigan, Ann Arbor; DR. H. M. SMITH, University of Illinois, Urbana; MR. N. J. WILIMOVSKY, Stanford University. It is intended that the Committee be a permanent one of the Society, reappointed annually, with occasional change of membership, especially if others competent in nomenclatural procedure are available and present members find they can no longer spare the time. The present Committee has been appointed to act until the next annual meeting of the Society.

In Declaration No. 10 of the International Commission on Zoological Nomenclature, the Commission stressed the importance of the formation of "specialist groups" for study of the nomenclature of particular divisions of the Animal Kingdom, and to advise the International Commission. There seem to have been no such groups in existence for ichthyology and herpetology and it is hoped that the present Committee will not only act as a

clearing house for problems in fish, amphibian and reptile nomenclature but also to gather information on nomenclatural problems which should be brought to the attention of the International Commission. It is anticipated that the Committee will keep in touch with similar committees of the American Society of Systematic Zoologists, the American Ornithologists' Union and the American Society of Mammalogists, especially on nomenclatural matters of general interest.

Names of Superior Categories

AT the 1950 annual meeting at Salt Lake City, the Committee on Fish Classification decided to adopt the STENZEL system of naming superior categories in fishes. Herpetologists present were not at all sure that they would prefer the same system for amphibians and reptiles. Attention was also called to the fact that any system of naming adopted by the Committee might have to be discarded if the International Zoological Congress comes to a decision in regard to the names of categories higher than the family. Consideration of the subject is definitely planned for the next Congress, to be held at Copenhagen in 1953. Due to these facts, PRESIDENT MYERS has requested the Society's recently appointed Committee on Zoological Nomenclature to take up the question from the viewpoint of both herpetologists and ichthyologists, so that a united front may be presented by the Society in support of our views, at the International Congress.

Poisonous Snakes

FOLLOWING upon December press reports that the U. S. Fish and Wildlife Service was considering regulation of the importation of live venomous snakes into the United States, PRESIDENT MYERS requested information from the Service. Reply from Mr. CLARENCE COTTAM, Assistant Director of the Service, indicates that they are concerned about the possible establishment of foreign poisonous snakes such as the Asiatic cobra in this country through accident, carelessness, or even intent, on the part of irresponsible amateurs or poorly equipped "roadside snake-zoos." No regulations have yet been drawn up, Mr. COTTAM points out, and it is not yet evident that any agency other than Congress can legally make them, but he feels that it is the duty of the Service to prevent the establishment of foreign dangerous species. He believes that importation or purchase of live foreign venomous snakes should be restricted, by permit, to responsible dealers, exhibitors and research workers. In reply, PRESIDENT MYERS pointed out that federal regulation might be difficult in a practical way and that most of the venomous species imported in numbers are tropical snakes which probably could not survive occasional winter cold spells, even in southern Florida or Louisiana. In view of the feeling for regulation on the part of the Service, PRESIDENT MYERS appointed a "Committee on Traffic in Venomous Reptiles" to study the matter and report at the June meeting in Chicago. Committee members are R. CONANT, Chairman; E. R. DUNN; and C. H. BOGERT.

News Notes

WORD has been received that Dr. J. L. McHUGH left the Scripps Institution of Oceanography in January, 1951, to take over the directorship of the Virginia Fisheries Laboratory. Before the war Dr. McHUGH was on the staff of the Pacific Biological Station, Nanaimo, British Columbia. Coming to the Scripps Institution of Oceanography in 1946 to complete requirements for the Ph.D. degree under Dr. CARL L. HUBBS, he was employed on the Cooperative Sardine Research Program from 1948 through 1950.

DR. ALFRED PERLMUTTER has recently been appointed Senior Aquatic Biologist (Marine) with the Bureau of Marine Fisheries, State of New York Conservation Department. His headquarters are at 65 West Sunrise Highway, Freeport, Long Island, N.Y. The position calls for the formulation of measures that will insure the maximum utilization of the marine resources of New York.

DR. CLARK HUBBS writes that Mr. MARION TOOLE has authorized the use of Game Commission funds for cataloging a fish collection which is being assembled at the University of Texas. It is called the Texas Game Fish and Oyster Commission Fish Collection, and is under the supervision of CLARK HUBBS.

Word is received from John Wiley and Sons, Inc., that they are now co-publishers (with Methuen and Company of London) of the Methuen Monographs on Biological Sub-

jects. Thus the series will be available in this country. The first group of jointly published manuscripts includes: *The Classification of Animals*, by W. T. CALMAN, 1949, 54 pp., \$1.25; and *Mendelism and Evolution*, by E. B. FORD, 5th ed., 1949, 122 pp., \$1.25. Scheduled for publication at an early date is *The Ecology of Animals*, by ELTON.

DR. BRAYTON EDDY, 51, died on July 17, 1950. Although primarily known as an entomologist, he was curator of reptiles for the New York Zoological Society, and had been a member of the ASIH since 1947.

Members of the ASIH have a just right to be proud of the recognition afforded them, collectively, in a recent article by Jarman (1950, *Sat. Eve. Post*, 223 (17): 186). According to him our organization is one of the seven "lesser-known groups" listed as being desirable convention material for hotels. Although it may be distressing to some that we are fifth on the list and that the MOVPER is rated above us, no small amount of comfort should be derived from the fact that we are placed above the ICOH-H.

J. L. KASK, formerly chief biologist with the Fisheries Division of the FAO of the United Nations, Washington, D. C., has been appointed Chief, Section of Research and Development, of the Pacific Oceanic Fishery Investigations at Honolulu, T. H.

DR. GRACE L. ORTON, formerly of Carnegie Museum, has accepted a position at Scripps Institution of Oceanography, to devote most of her time to the study of larval fishes.

MILNER B. SCHAEFFER, who left Honolulu in December, is now Director of Investigations of the newly formed Inter-American Tropical Tuna Commission. His address is c/o Scripps Institution of Oceanography, La Jolla, California.

Word was received on December 26 of the death of LEO S. BERG, internationally known Russian ichthyologist. DR. BERG was elected Honorary Foreign Member of the Society in 1937.

An Austrian member of the Society, HERALD KUNZL, of 2 Parkweg, Vienna—Wr. Neudorf, Austria, is interested in exchanging living reptiles and amphibians for use in studies of animal psychology.

The annual meeting of the Atlantic Fisheries Biologists Society was held at St. Andrews, New Brunswick, Canada, on September 29 to October 1, 1950, for the purpose of promoting the interchange of ideas on fisheries research through informal discussions. HARRY W. EVERHART and LYNDON H. BOND of Orono, Maine, were elected President and Secretary-Treasurer for the coming year.

The Secretary is interested in purchasing either short or long runs of COPEIA, these to be used to complete sets for sale to libraries and to members.

The editors wish to express their appreciation to MRS. HELEN T. GAIGE for her assistance in preparing the index to COPEIA for 1950.

Copeia 1950 Mailing Dates

COPEIA for 1950 was entered as mail in the U. S. Post Office in Ann Arbor as follows: No. 1 on March 30, No. 2 on June 29, No. 3 on September 6, and No. 4 on December 22.

ASIH 1951 Annual Meetings

THE Society will hold its 31st Annual Meeting at the Chicago Natural History Museum, Chicago, Illinois, on June 28, 29 and 30, 1951. The American Society of Mammalogists will meet at the same time and place. Hotel Stevens will be official headquarters. The Hotel Harrison, nearby, is also suggested for accommodations. Make reservations direct, specifying the type of quarters desired. If you wish to participate in the program send the following information regarding your paper to KARL P. SCHMIDT, Chicago Natural History Museum, Roosevelt Road and Lake Shore Drive, Chicago 5, Illinois, by June 1, 1951: (1) Title of paper, (2) Name of speaker, (3) Time needed in minutes (normally not more than 15), (4) Projection equipment needed (be specific). If you wish to exhibit photographs or other material, indicate the type and exact amount of space needed. The Board of Governors will meet on June 27, 1951 at 8:00 P.M. at Hotel headquarters. In addition to KARL P. SCHMIDT (Chairman) the local committee includes LOREN WOODS (Vice-chairman), CLIFFORD H. POPE, HOWARD K. GLOYD, WALTER H. CHUTE, WALTER C. BROWN, JAMES S. KEZER and ROBERT SNEDIGAR.

The Western Division of the Society plans to meet at the University of Southern California at Los Angeles in connection with AAAS meetings the week of June 18-23. It is planned to hold a fish symposium Tuesday morning and fish papers Tuesday afternoon, June 19; herpetology symposium and papers on Wednesday the 20th.

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